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c.2

# APPENDIX SUPPLEMENT

## OPERATIONAL VARIABLES AND LIMITATIONS OF DIRECT FILTRATION

1975

RESEARCH REPORT NO. W54



Ontario

Ministry  
of the  
Environment

The Honourable  
William G. Newman,  
Minister

Everett Biggs,  
Deputy Minister

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R54A

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APPENDIX SUPPLEMENT

OPERATIONAL VARIABLES AND LIMITATIONS

OF

DIRECT FILTRATION

by

W. R. Hutchison

Water Technology Section  
Pollution Control Branch

Research Report No. W54

January 1975

Ministry of the Environment  
135 St. Clair Ave. W.,  
Toronto, Ont.

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APPENDIX 1

High Raw Water Turbidity

Oct. 13, 1972	Sarnia
Oct. 16, 1972	Sarnia
Jan. 28, 1974	Sarnia
July 4, 1973	Sarnia

APPENDIX 1

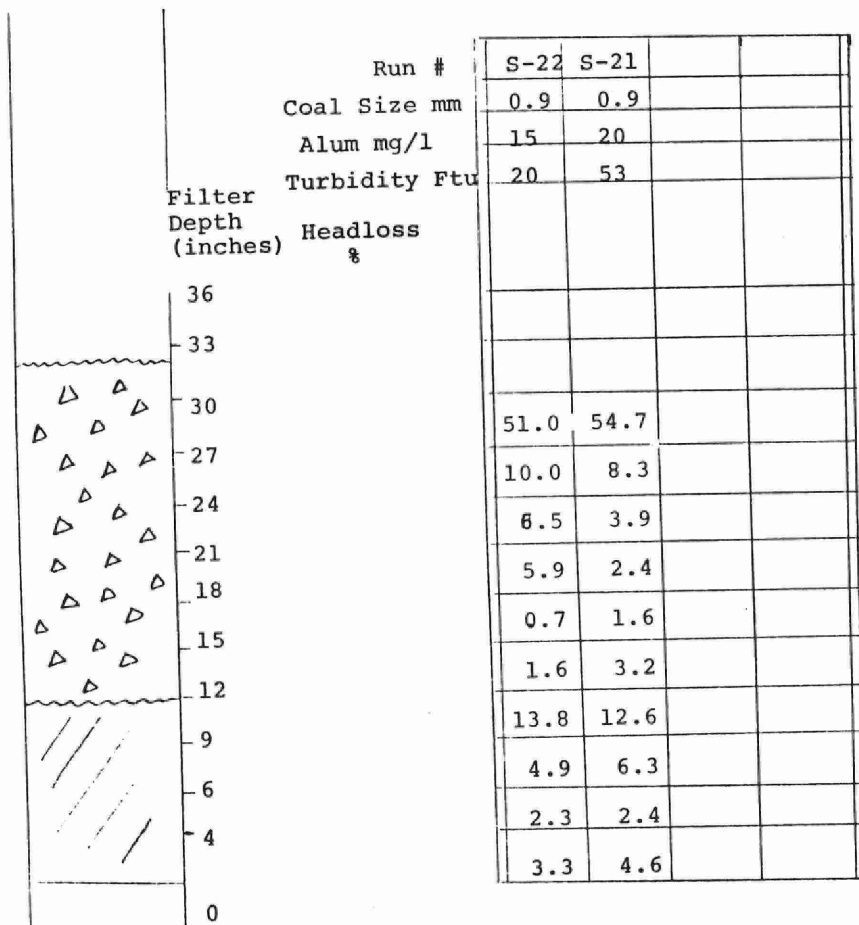
DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum ppm	Poly ppm	Raw FTU	Eff. FTU	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm													
Oct 16	S-22	54	12	0.45	20	0.9	4	15	0	20*	0.18	20	14.5	6	6	11.5	2,750	74	26
			13	0.45	21	1.0	4	15	0	20	0.18	20	14.5	4.5	4.5	11.5	2,750	54	46
			12	0.45	20	1.55	4	15	0	20	0.20	20	14.5	3	3	7.2	1,750	42	58
Oct 13	S-21	54	12	0.45	20	0.9	4	20	0	53*	-	20	14.5	3.5	3.5	2.3	550	71	29
			13	0.45	21	1.0	4	20	0	53	-	20	14.5	3	3	2	500	39	61
			12	0.45	20	1.55	4	20	0	53	-	20	14.5	2.5	2.5	1.5	350	38	62
Jan 28	61	33	13	0.45	22	0.9	4	12	0	14**	0.23	20	14.5	5.8	5.8	15.0	3,600	71	29
			13	0.45	22	1.05	4	12	0	14	0.20	20	14.5	4.3	4.3	13.5	3,250	57	43
			13	0.45	22	1.55	4	12	0	14	0.23	20	14.5	4.3	4.3	11.8	2,850	54	46
July 4	18	53	13	0.45	22	0.9	4	15	0	20**	0.14	20	14.5	7.5	7.5	9.5	2,300	87	13
			13	0.45	22	1.05	4	15	0	20	0.20	20	14.5	4.0	4.0	8.5	2,050	67	33
			13	0.45	22	1.55	4	15	0	20	0.20	20	14.5	2.5	2.5	4.5	1,100	54	46

\* Natural Turbidity  
\*\* Turbidity added to raw water

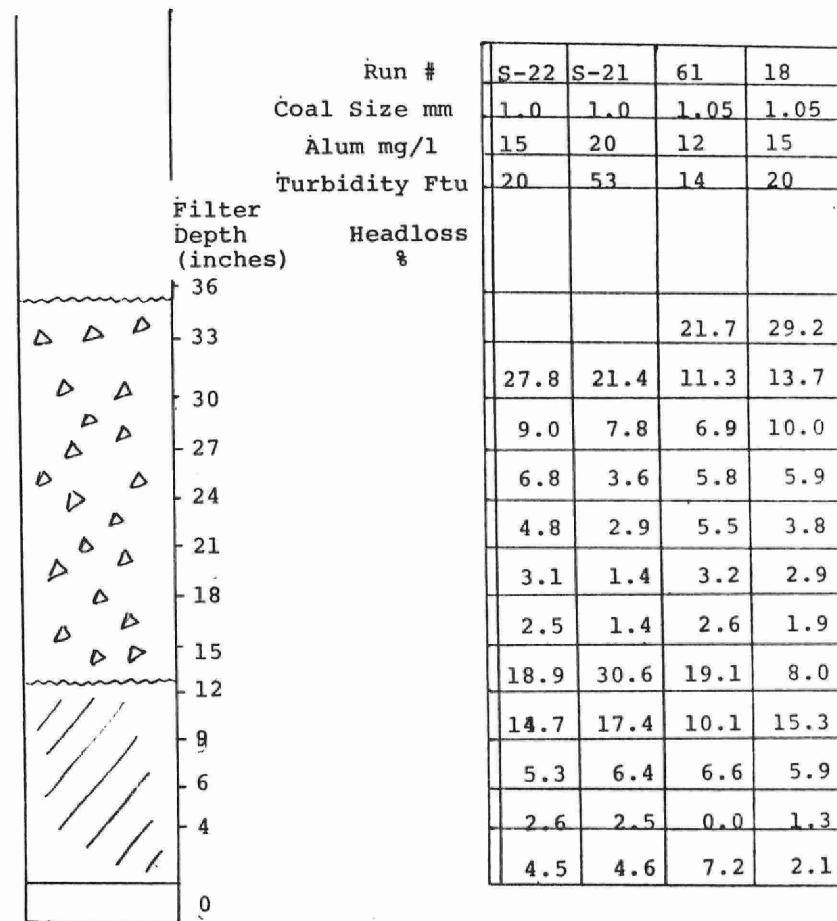
Appendix 1

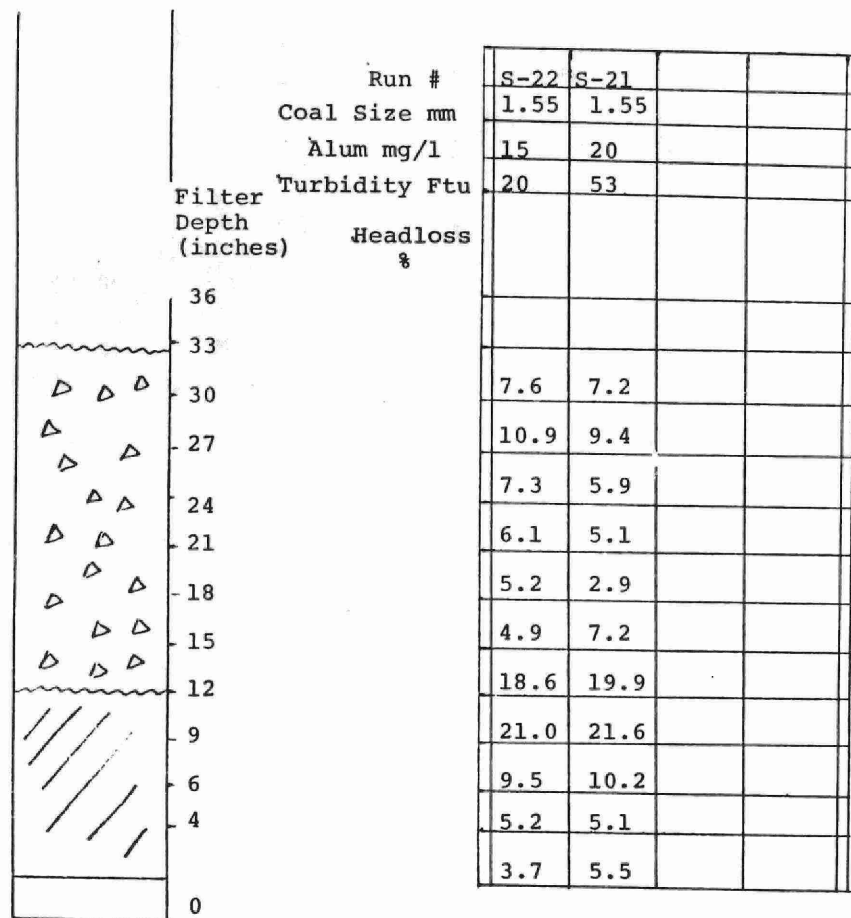
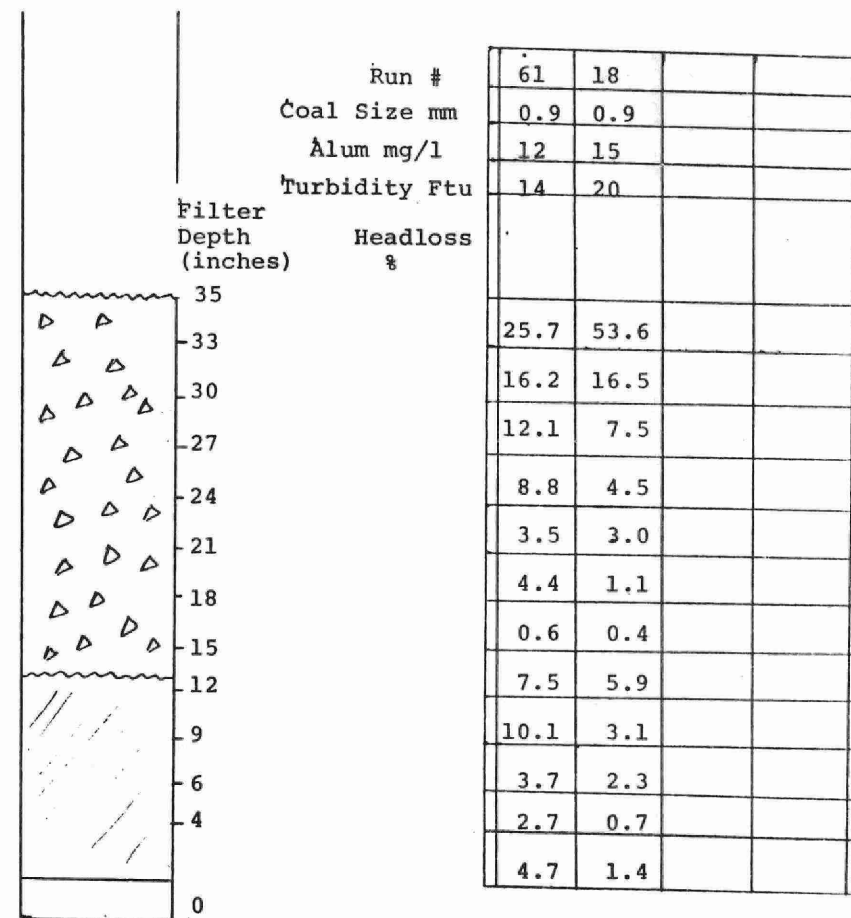
HEADLOSS DISTRIBUTION RESULTS



Appendix 1

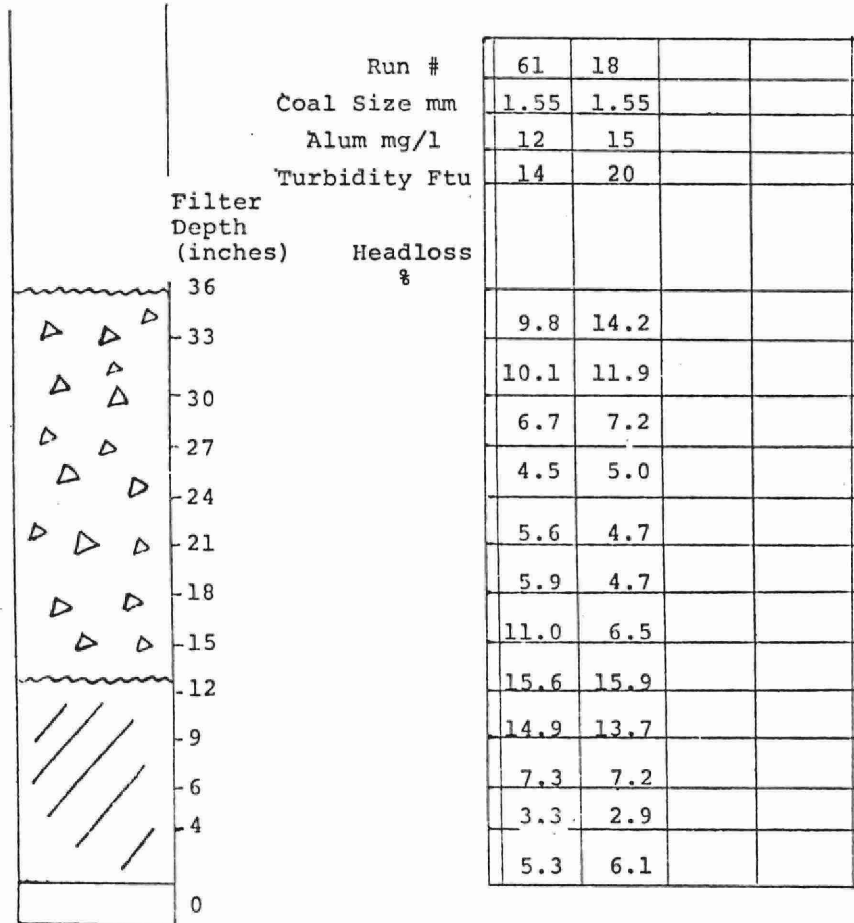
HEADLOSS DISTRIBUTION RESULTS



HEADLOSS DISTRIBUTION RESULTSHEADLOSS DISTRIBUTION RESULTS

# Appendix 1

## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 2

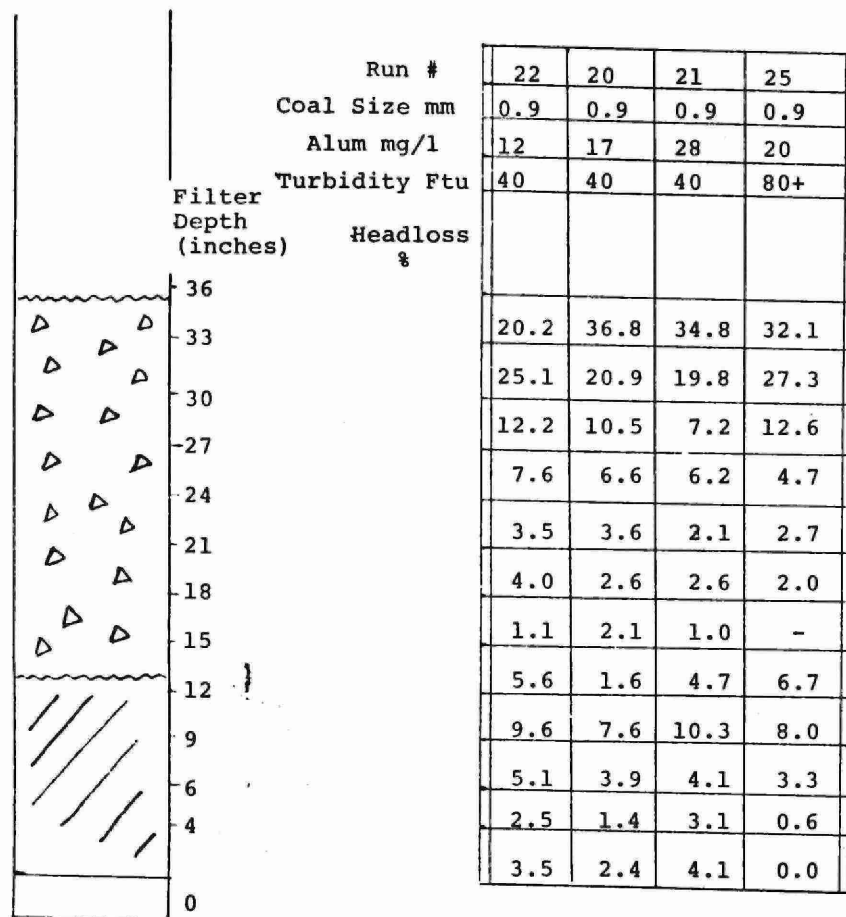
High Raw Water Turbidity

July 12, 1973	Sarnia
July 10, 1973	Sarnia
July 11, 1973	Sarnia
July 18, 1973	Sarnia

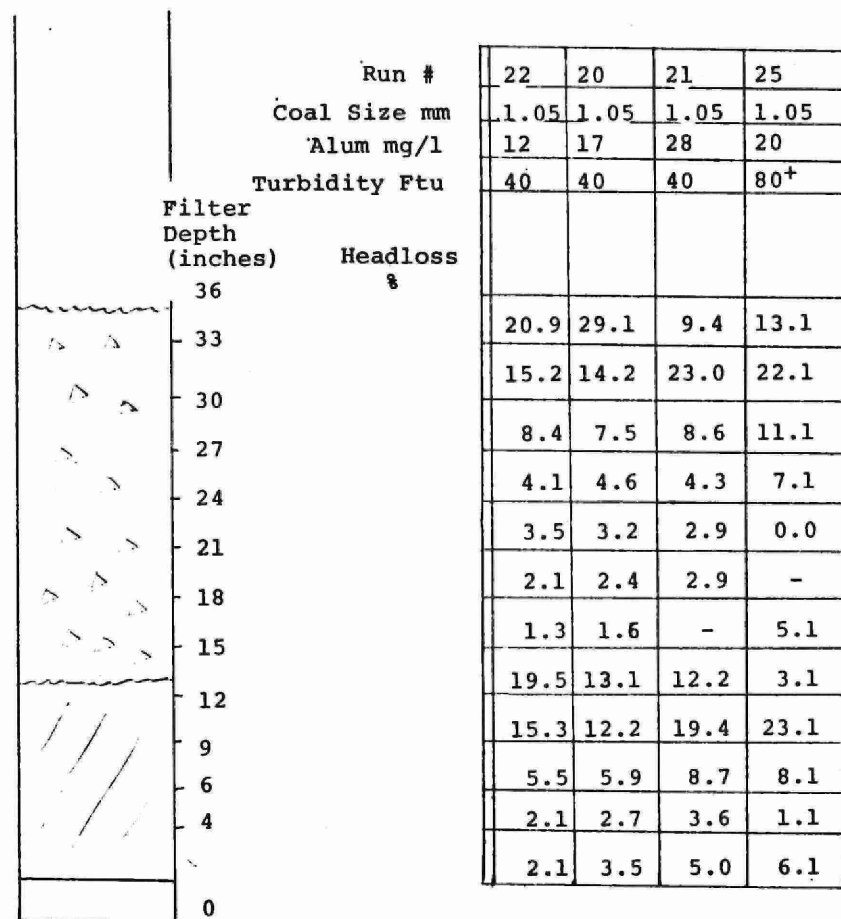
## DIRECT FILTRATION

\* Turbidity added to raw water

## Appendix 2

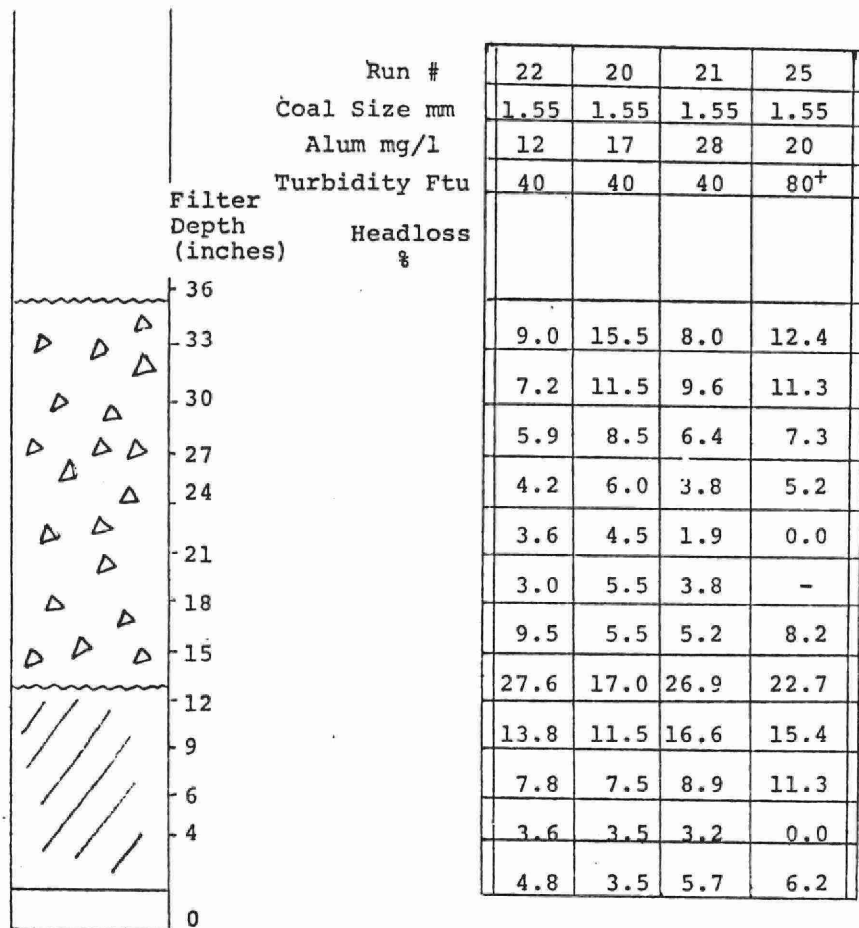
HEADLOSS DISTRIBUTION RESULTS

## Appendix 2

HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 3

High Raw Water Turbidity

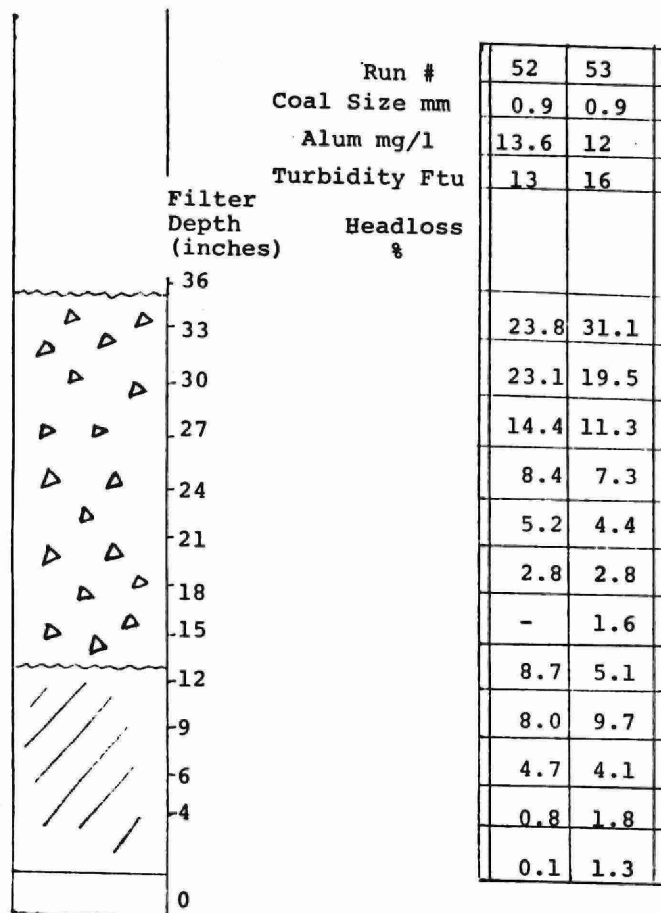
Oct. 25, 1973	Sarnia
Oct. 29, 1973	Sarnia

## DIRECT FILTRATION

\* Turbidity added to raw water.

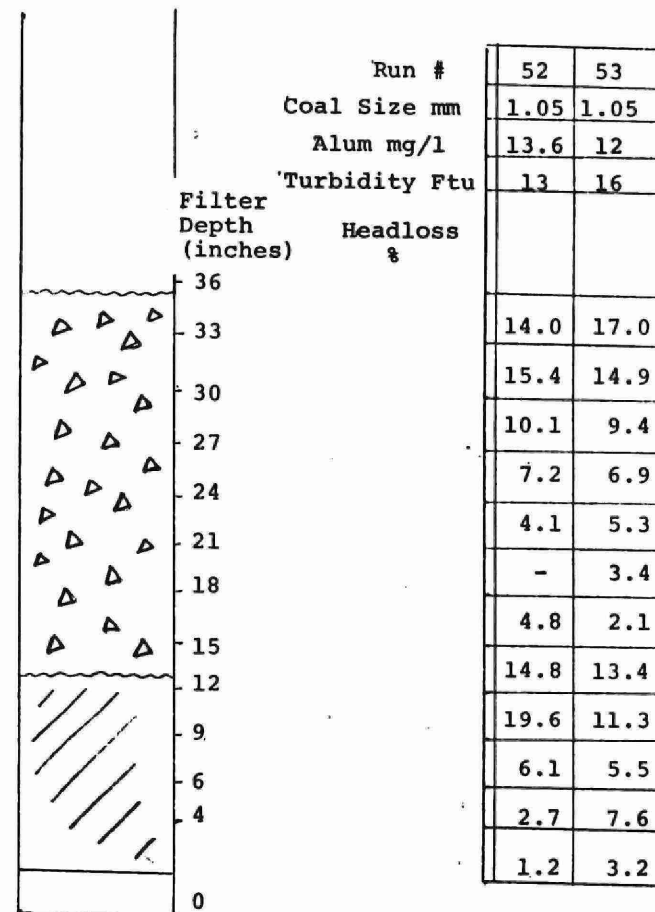
# Appendix 3

## HEADLOSS DISTRIBUTION RESULTS

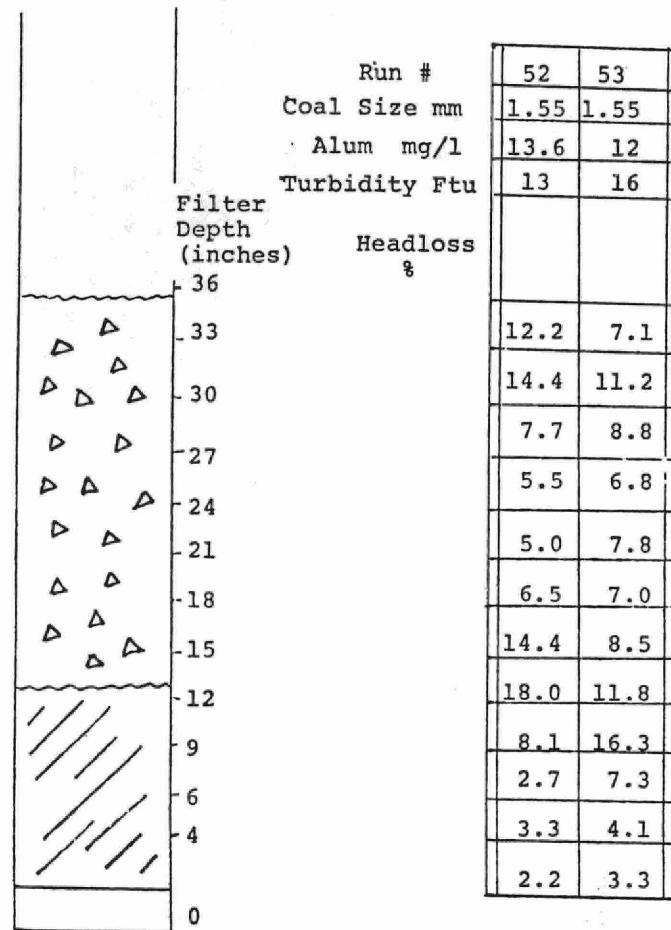


# Appendix 3

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 4

High Raw Water Turbidity

Filtration Rate 6 Igpm/sq ft

Oct. 18, 1972

Oct. 17, 1972

Oct. 12, 1972

APPENDIX 4

DIRECT FILTRATION

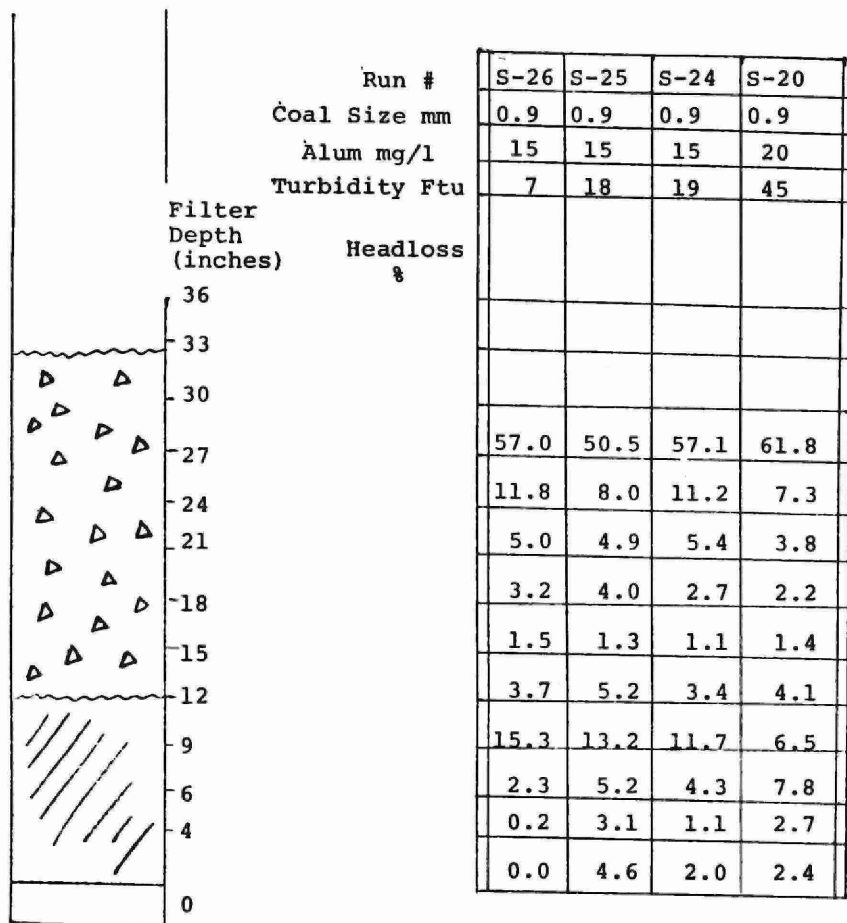
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Oct 18	S-26	48	12	0.45	20	0.9	6	15	0	7	0.18	20	8	8	-	8.7	3,100	78	22
			13	0.45	21	1.0	6	15	0	7	0.18	20	8	8	-	10.0	3,600	54	46
			12	0.45	20	1.55	6	15	0	7	0.18	20	8	8	-	9.5	3,400	33	67
Oct 17	S-25	54	12	0.45	20	0.9	6	15	0	18	0.19	20	18	4.2	4.2	4.5	1,600	69	31
			13	0.45	21	1.0	6	15	0	18	0.19	20	18	3.6	3.6	4.2	1,500	51	49
			12	0.45	20	1.55	6	15	0	18	0.23	20	18	2.5	2.5	2.8	1,000	40	60
Oct 17	S-24	54	12	0.45	20	0.9	6	15	0	19	0.20	20	14.5	5.6	5.6	5.8	2,100	77	23
			13	0.45	21	1.0	6	15	0	19	0.21	20	14.5	4	4	5.2	1,850	55	45
			12	0.45	20	1.55	6	15	0	19	0.25	20	14.5	3	3	3.6	1,300	33	67
Oct 12	S-20	54	12	0.45	20	0.9	6	20	0	45	0.30	20	14.5	3.5	3.5	2.5	900	76	24
			13	0.45	21	1.0	6	20	0	45	0.30	20	14.5	3	3	2.5	900	52	48
			12	0.45	20	1.55	6	20	0	45	0.30	20	14.5	2.8	2.8	2.0	700	37	63
										*	Natural								

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-15-

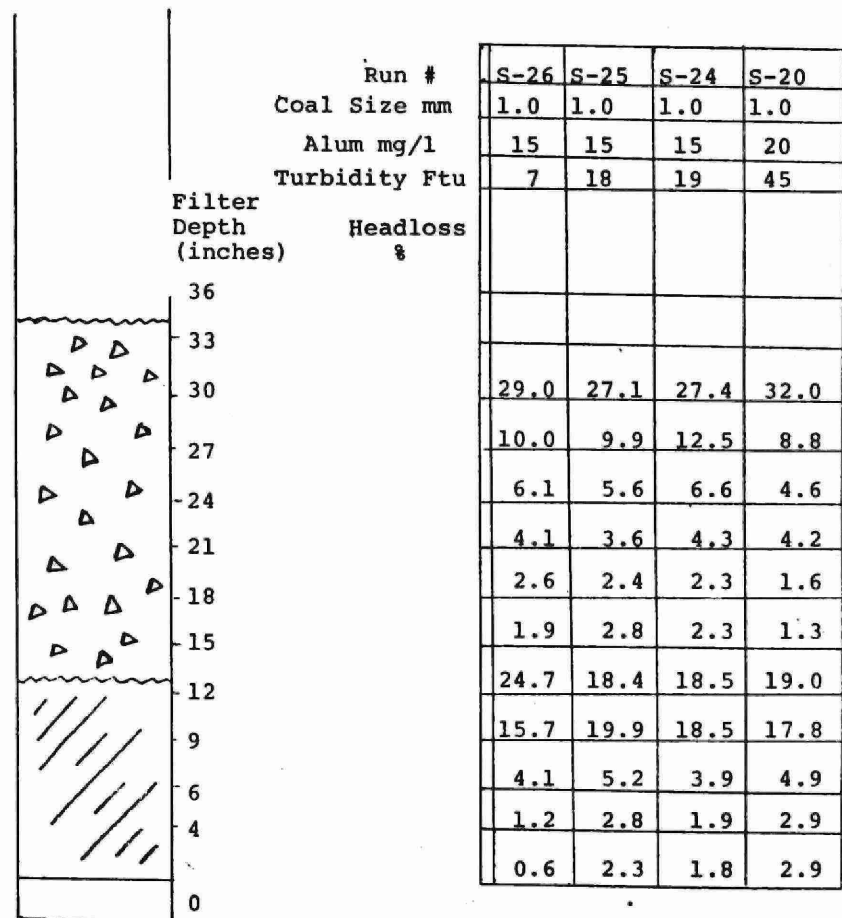
# Appendix 4

## HEADLOSS DISTRIBUTION RESULTS



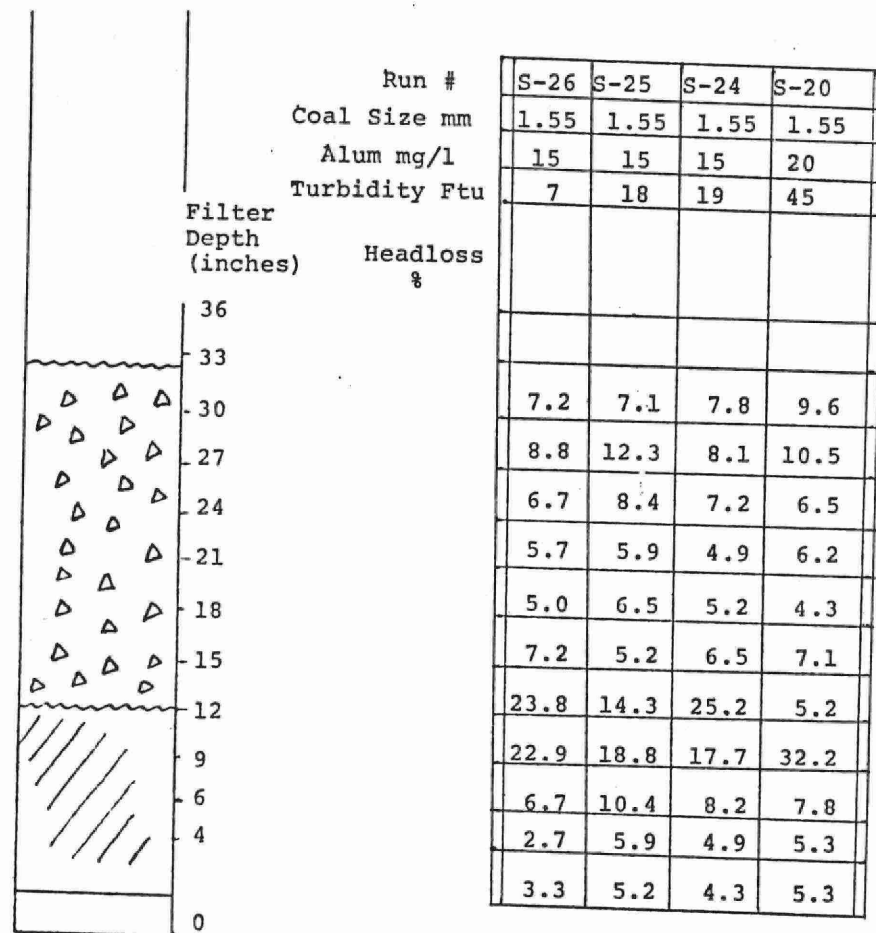
# Appendix 4

## HEADLOSS DISTRIBUTION RESULTS





## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 5

High Raw Water Turbidity  
Polymer as a Filter Aid

July 17, 1973  
July 23, 1973  
Aug. 9, 1973

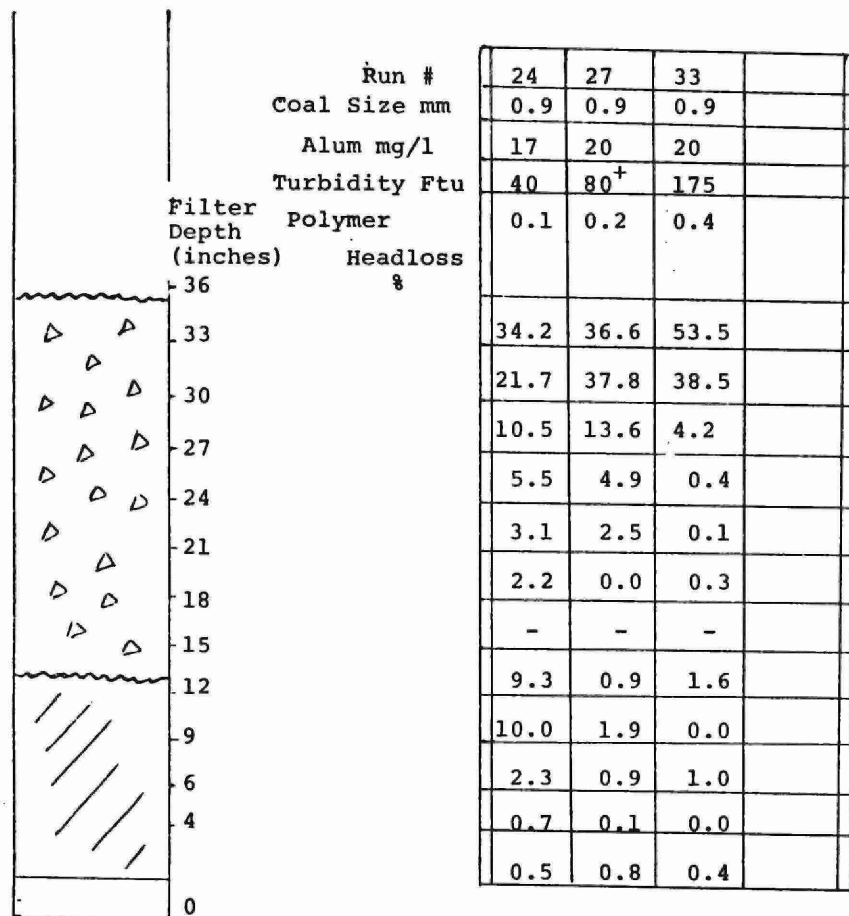
## APPENDIX 5

## DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm *	FTU	FTU **								
July 17	24	65	13	0.45	22	0.9	4	17	0.1	40	0.17	20	18	8	-	13.0	3,100	77	29
			13	0.45	22	1.05	4	17	0.1	40	0.18	20	18	6.5	6.5	12.0	2,900	57	43
			13	0.45	22	1.55	4	17	0.6	40	0.25	20	18	8	-	9.2	2,200	92	8
July 23	27	68	13	0.45	22	0.9	4	20	0.20	80+	0.20	20	18	8	-	11	2,650	95	5
			13	0.45	22	1.05	4	20	0.25	80+	0.25	20	18	8	-	11	2,650	77	23
			13	0.45	22	1.55	4	20	0.45	80+	0.25	20	18	8	-	9	2,150	95	5
Aug 9	33	65	13	0.45	22	0.9	4	20	0.4	175	0.28	20	18	8	-	7.5	1,800	97	3
			13	0.45	22	1.05	4	20	0.4	175	0.35	20	18	8	-	9.8	2,350	94	6
			13	0.45	22	1.55	4	20	0.4	175	0.31	20	18	8	-	12.5	3,000	71	29
												</							

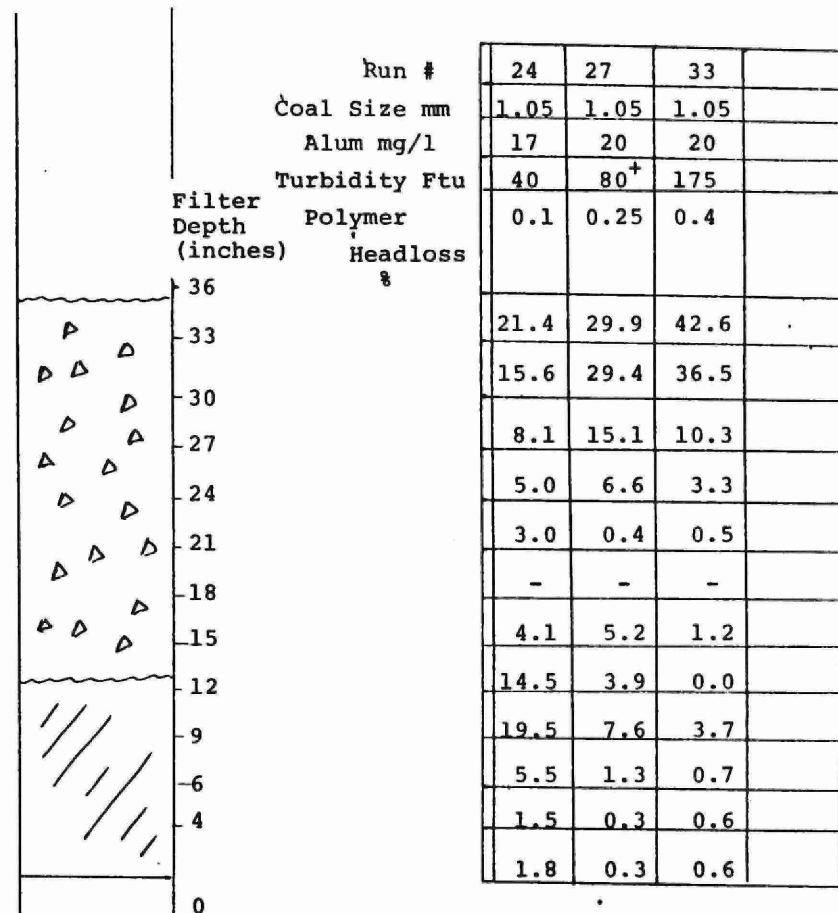
# Appendix 5

## HEADLOSS DISTRIBUTION RESULTS

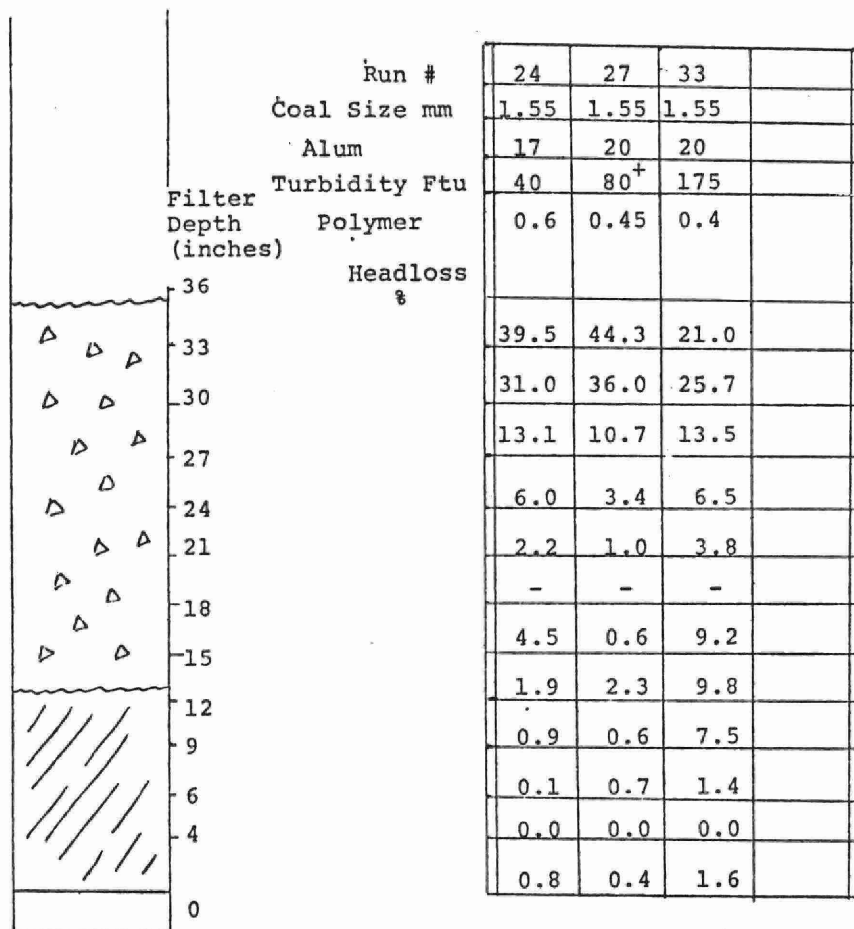


# Appendix 5

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 6

High Raw Water Turbidity  
with  
Polymer as a Filter Aid

Oct. 24, 1972  
Oct. 25, 1972

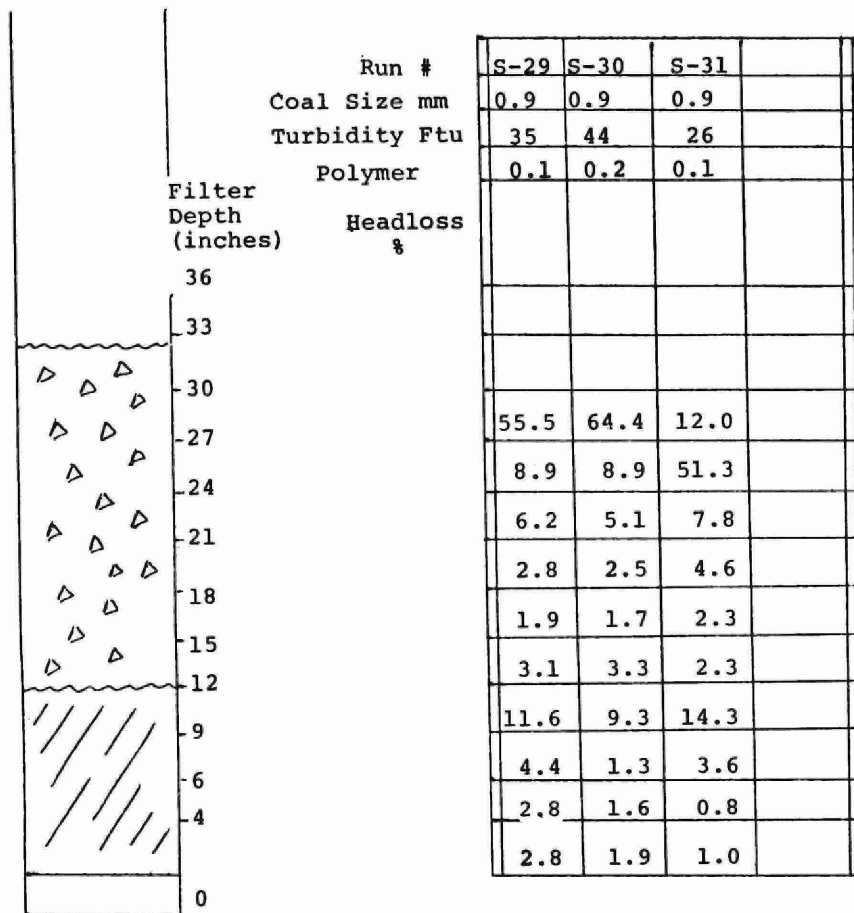
1

[illegible]

\*\*

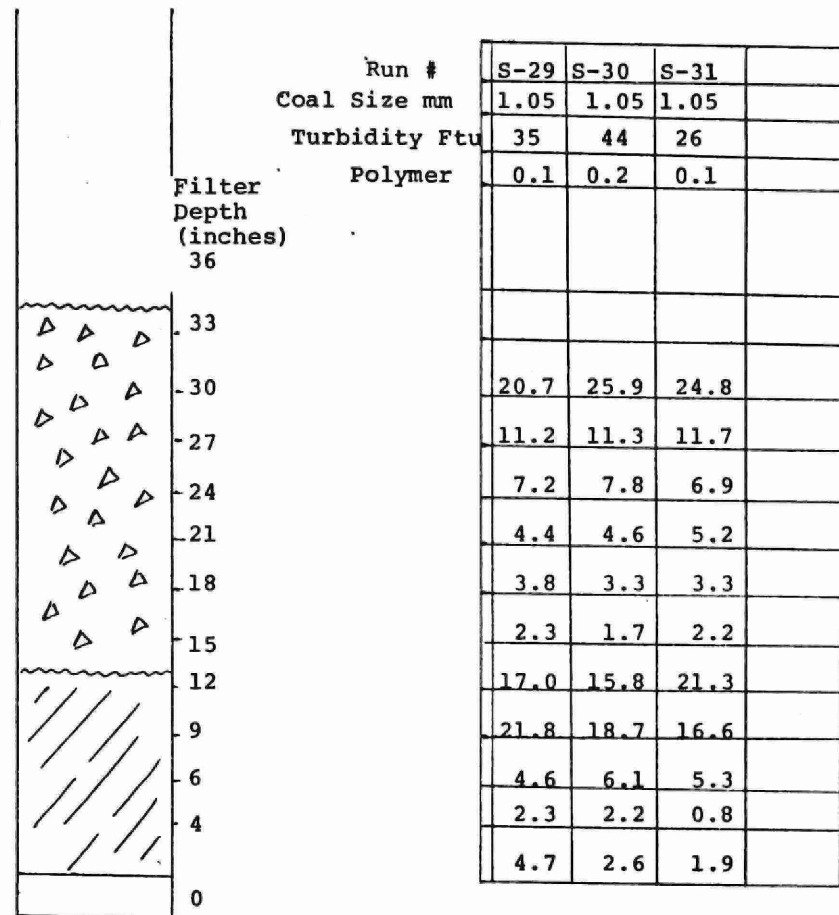
# Appendix 6

## HEADLOSS DISTRIBUTION RESULTS



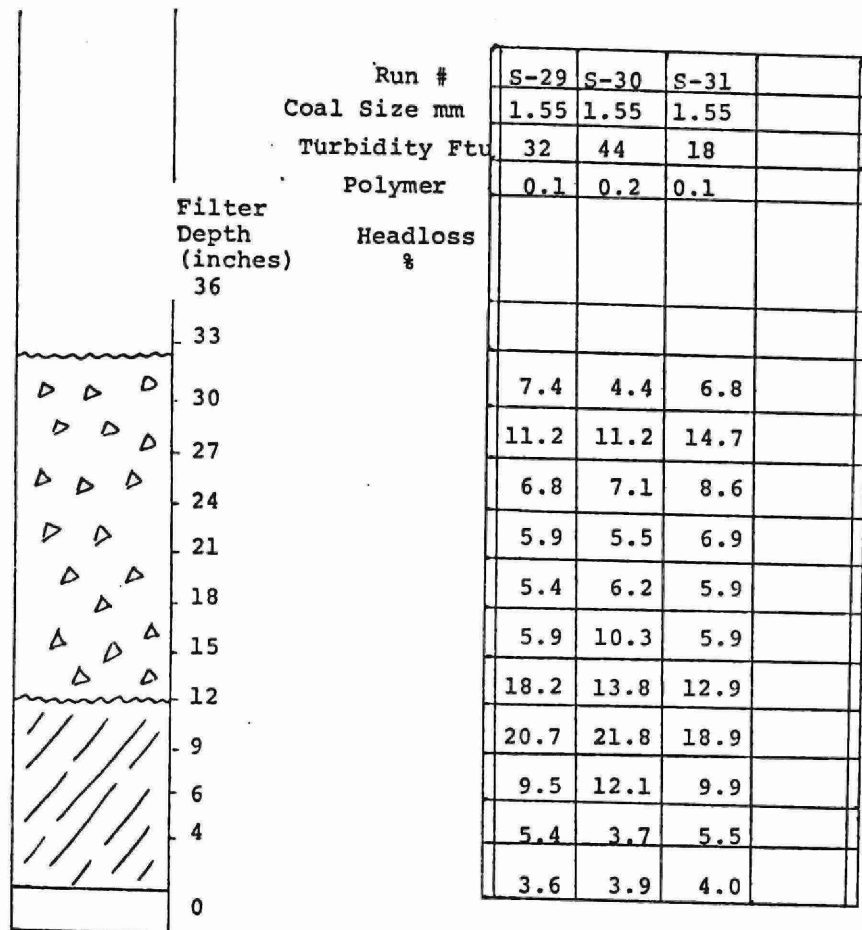
# Appendix 6

## HEADLOSS DISTRIBUTION RESULTS





## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 7

High Raw Water Turbidity  
Polymer with as a Filter Aid

Feb. 6, 1974  
Feb. 7, 1974  
Feb. 8, 1974

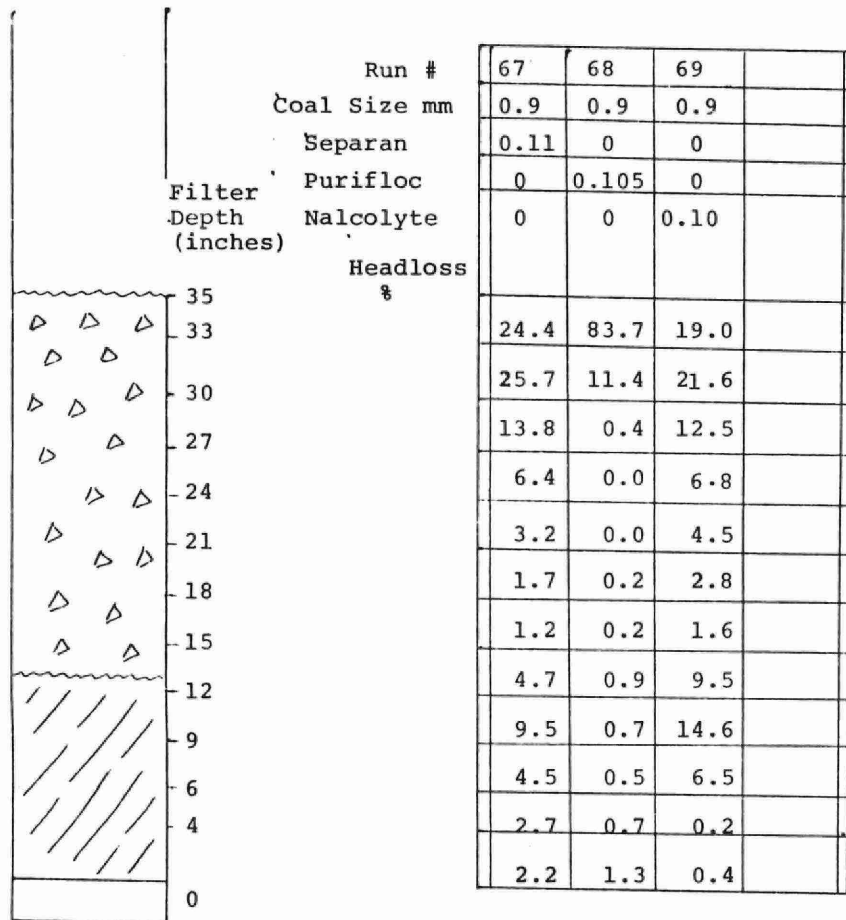
APPENDIX 7

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU x	FTU								
Feb 6	67	33	13	0.45	22	0.9	4	18	0.11*	32	0.23	20	28	7.0	7.0	9.3	2,250	76	24
			13	0.45	22	1.05	4	19	0.11*	32	0.23	20	28	7.0	7.0	8.8	2,100	55	45
			13	0.45	22	1.55	4	19	0.11*	32	0.23	20	28	5.4	5.4	7.5	1,800	44	56
Feb 7	68	33	13	0.45	22	0.9	4	18	0.105**	30	0.19	20	28	8	-	3.0	700	96	4
			13	0.45	22	1.05	4	18	0.105**	31	0.21	20	28	8	-	4.4	1,050	94	6
			13	0.45	22	1.55	4	18	0.105**	30	0.19	20	28	8	-	5.7	1,350	95	5
Feb 8	69	33	13	0.45	22	0.9	4	18	*** 0.10	31	0.16	20	28	8	-	10.2	2,450	68	32
			13	0.45	22	1.05	4	18	*** 0.10	31	0.18	20	28	5.6	5.6	10.0	2,400	53	47
			13	0.45	22	1.55	4	18	*** 0.10	31	0.16	20	28	6.1	6.1	10.0	2,400	43	57

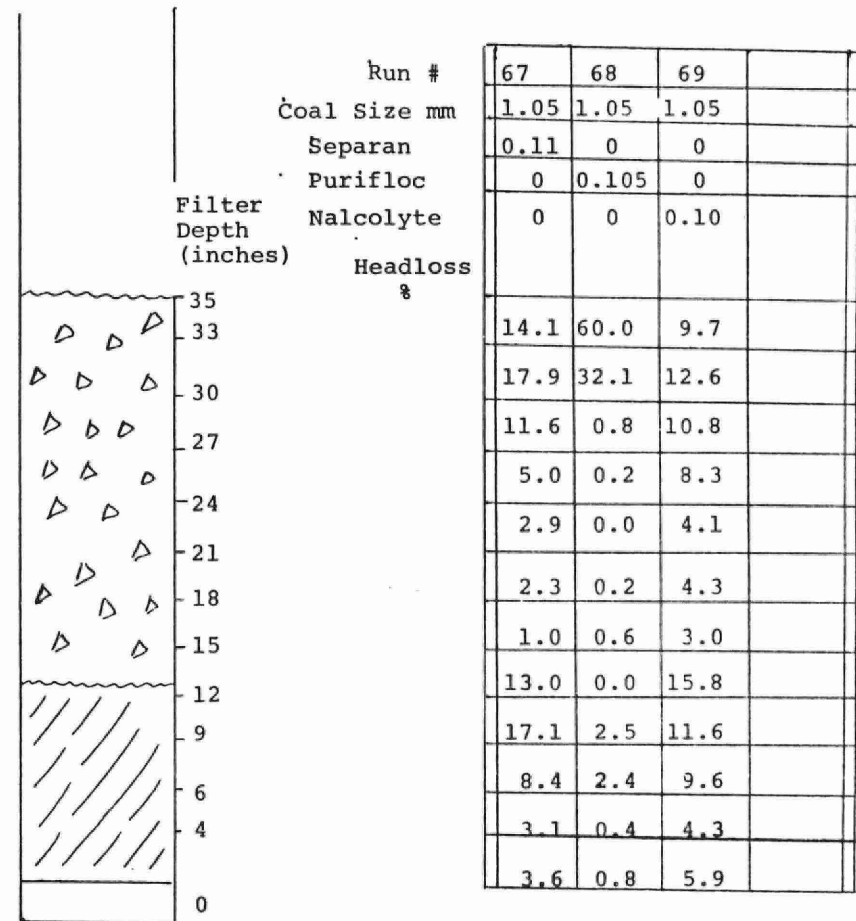
## Appendix 7

## HEADLOSS DISTRIBUTION RESULTS

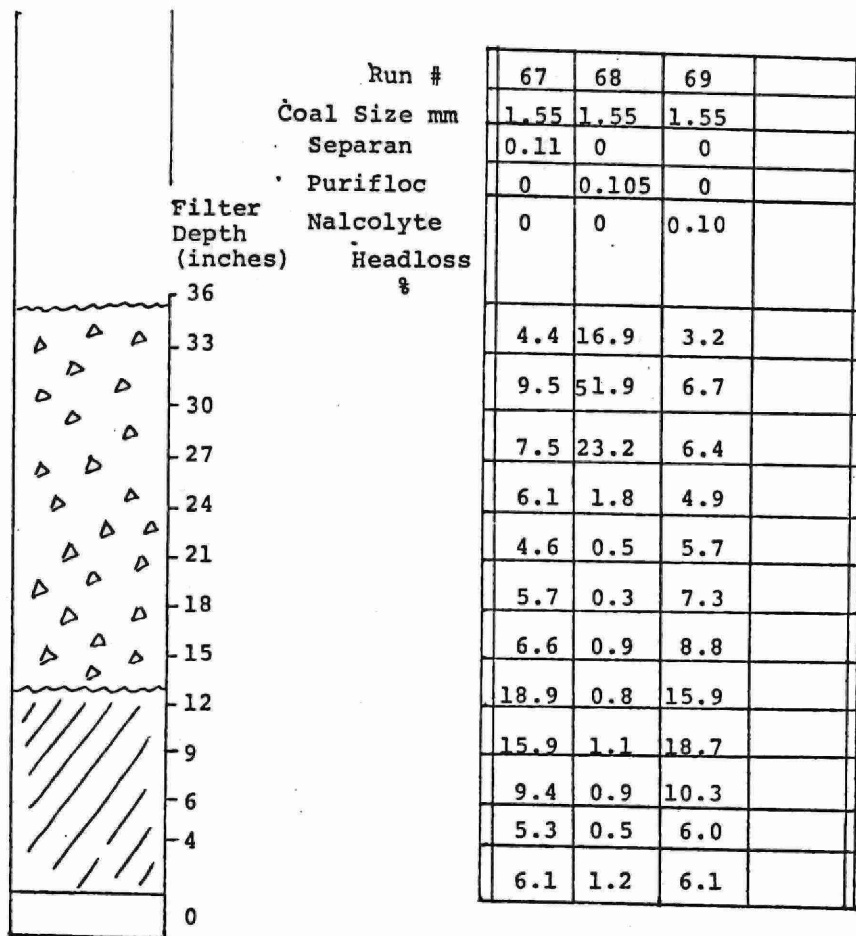


## Appendix 7

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



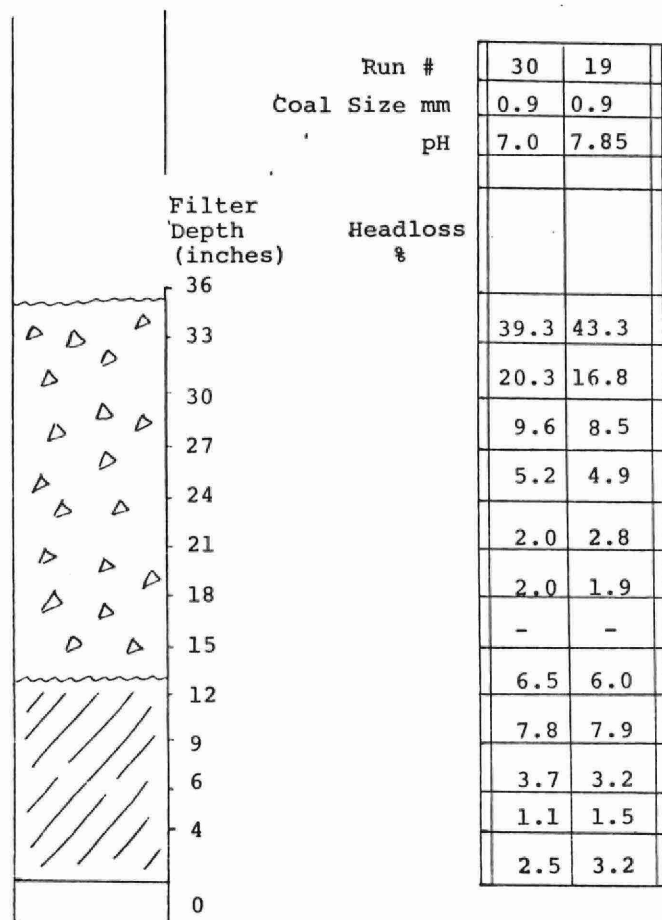
## APPENDIX 8

## DIRECT FILTRATION

[illegible]

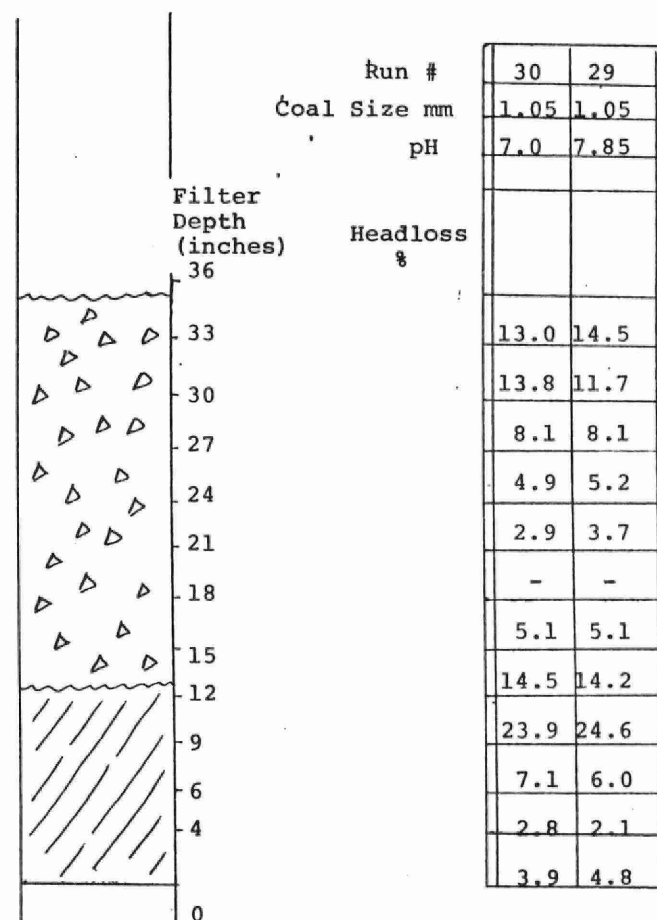
# Appendix 8

## HEADLOSS DISTRIBUTION RESULTS

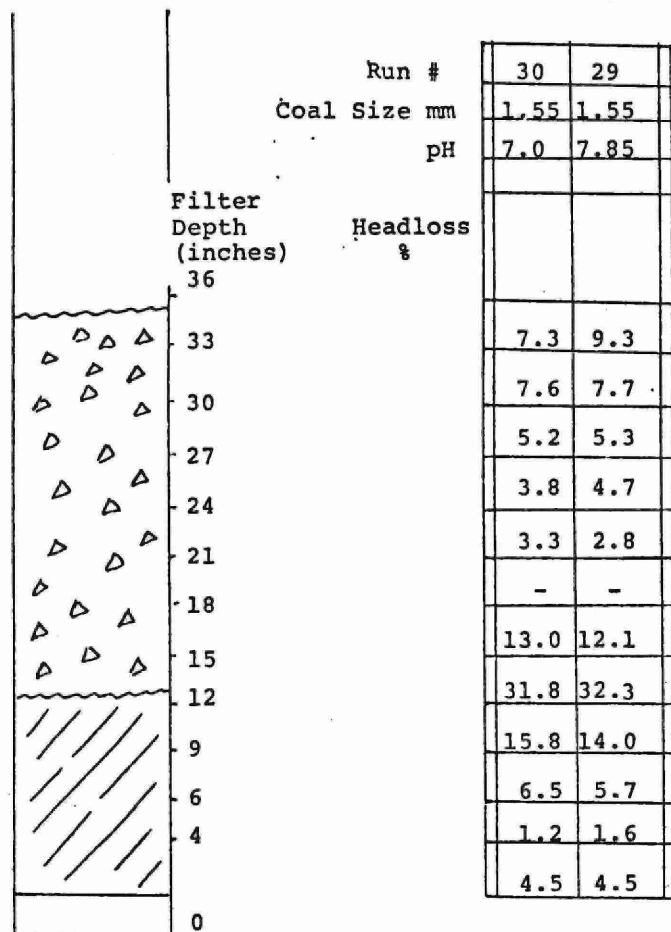


# Appendix 8

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS





APPENDIX 9

Various Alum Dosages

at a

Filtration Rate of 4 Igpm/sq ft

Sept. 27, 1972

Sept. 25, 1972

June 13, 1972

Oct. 16, 1972

Aug. 21, 1972

APPENDIX 9

DIRECT FILTRATION

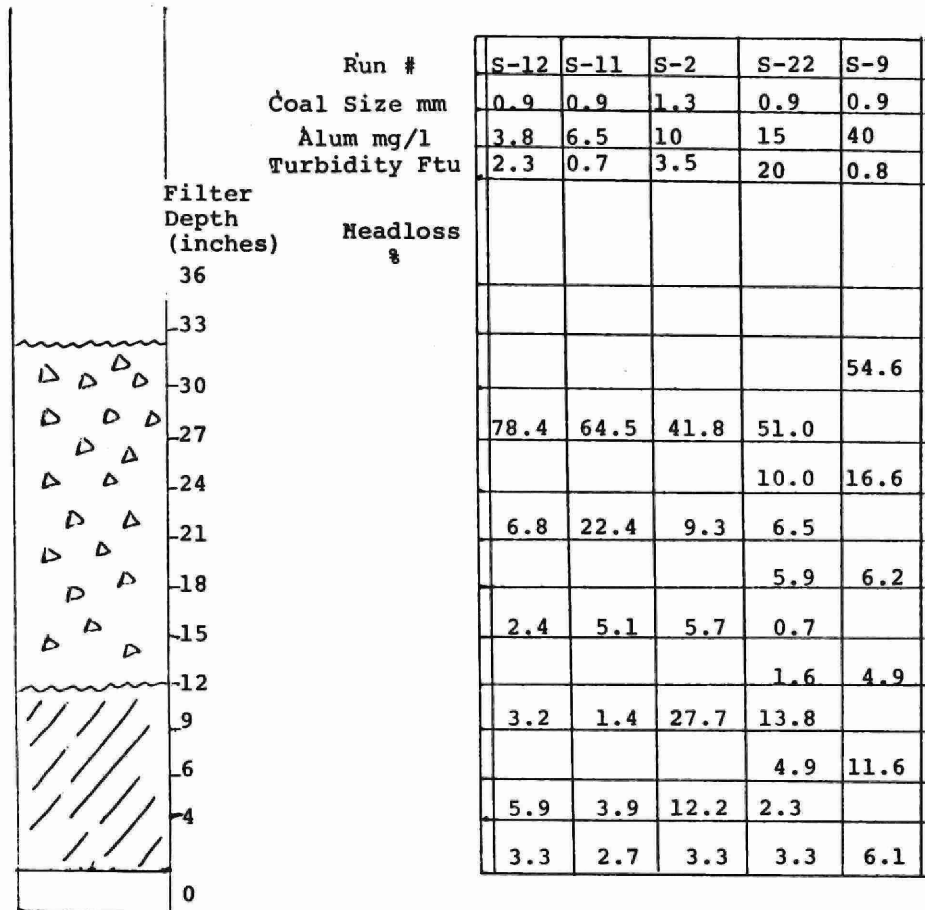
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
27 Sept	S-12	63	12	0.45	20	0.9	4	3.8	0	2.3	0.25	20	14.5	8	-	39	9,350	88	12
			12	0.45	21.5	1.0	4	3.8	0	2.3	0.25	20	14.5	3.7	-	48	11,500	61	39
			12	0.45	20	1.5	4	3.8	0	2.3	0.25	20	14.5	3.2	-	48	11,500	38	62
25 Sept	S-11	63	12	0.45	20	0.9	4	6.5	0	0.7	0.16	20	14.5	8	-	28	6,700	92	8
			12	0.45	21.5	1.0	4	6.5	0	0.7	0.16	20	14.5	8	-	38	9,100	67	33
			12	0.45	20	1.5	4	6.5	0	0.7	0.16	20	14.5	8	-	34.5	8,300	68	32
13 June	S-2	50	12	0.45	25	1.0	4	10	0	3.5	0.15	20	14.5	8	-	16.2	3,900	87	13
			12	0.45	20	1.3	4	10	0	3.5	0.15	20	14.5	6	6	17.5	4,200	57	43
			12	0.45	20	1.55	4	10	0	3.5	0.15	20	14.5	5	5	17	4,100	53	47
Oct 16	S-22	54	12	0.45	20	0.9	4	15	0	20	0.18	20	14.5	6	6	11.5	2,750	74	26
			12	0.45	21	1.0	4	15	0	20	0.18	20	14.5	4.5	4.5	11.5	2,750	54	46
			12	0.45	20	1.55	4	15	0	20	0.20	20	14.5	3	3	7.2	1,750	42	58
Aug 21	S-9	66	12	0.45	20	0.9	4	40	0	0.8	0.10	20	14.5	7	7	8	1,900	82	18
			12	0.45	22	1.0	4	40	0	0.8	0.10	20	14.5	5	5	7.7	1,850	52	48
			12	0.45	20	1.5	4	40	0.35	0.8	0.10	20	14.5	7	7	8	1,900	48	52
										* Natural									

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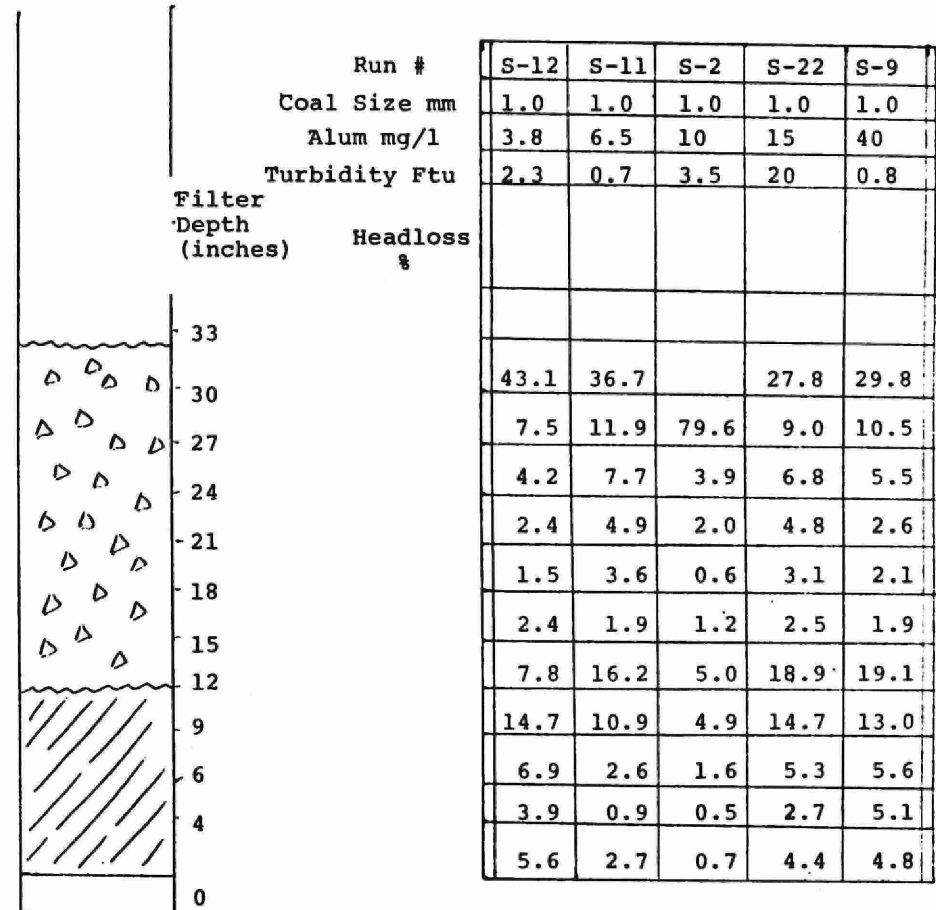
# Appendix 9

## HEADLOSS DISTRIBUTION RESULTS

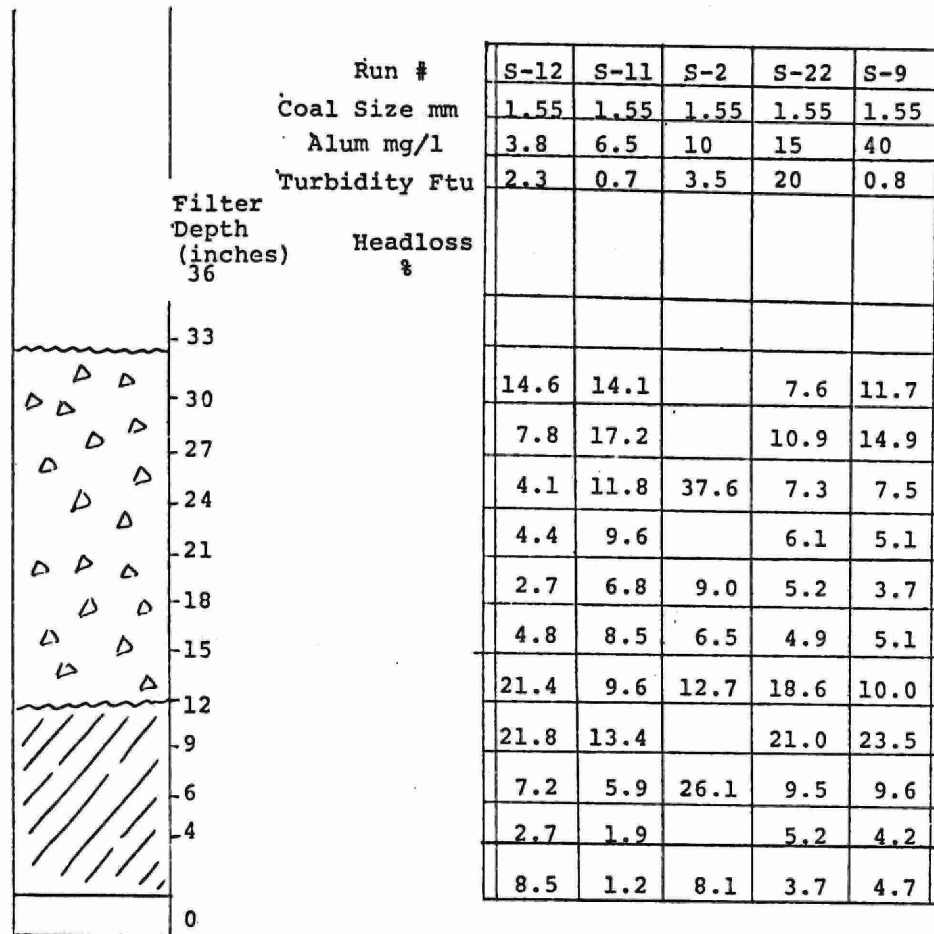


# Appendix 9

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 10

Various Alum Dosages

at a

Filtration Rate of 6 Igpm/sq ft

Oct. 30, 1972

Oct. 19, 1972

Oct. 11, 1972

Oct. 20, 1972

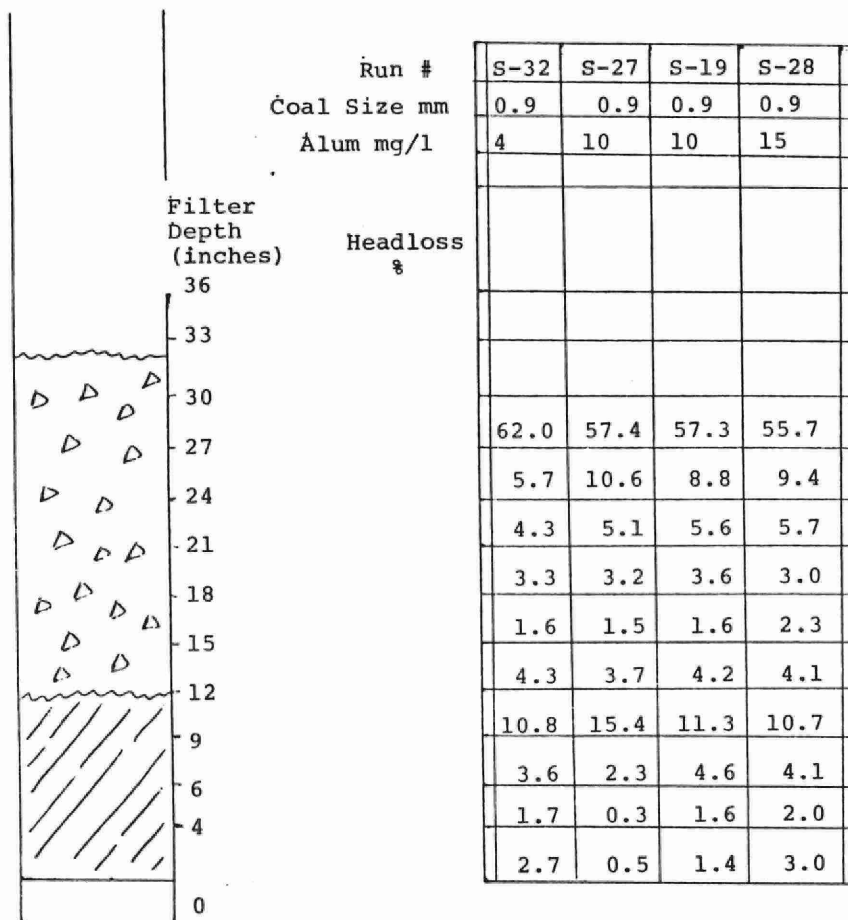
APPENDIX 10

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Oct 30	S-32	47	12	0.45	20	0.9	6	4	0	1.5	0.18	20	14.5	8	-	18	6,500	77	23
			13	0.45	21	1.0	6	4	0	1.5	0.18	20	14.5	8	-	27	9,700	46	54
			12	0.45	20	1.55	6	4	0	1.5	0.25	20	14.5	8	-	28	10,050	28	72
Oct 19	S-27	48	12	0.45	20	0.9	6	10	0	4.5	0.25	20	14.5	8	-	12.2	4,400	78	22
			13	0.45	21	1.0	6	10	0	4.5	0.25	20	14.5	6.7	6.7	12.2	4,400	55	45
			12	0.45	20	1.55	6	10	0	4.5	0.25	20	14.5	4.5	4.5	8	2,400	40	60
Oct 11	S-19	57	12	0.45	20	0.9	6	10	0	8	0.16	50	14	8	-	11.5	4,150	77	23
			13	0.45	21	1.0	6	10	0	8	0.15	50	14	7.5	7.5	12	4,300	49	51
			12	0.45	20	1.55	6	10	0	8	0.18	50	14	5.5	5.5	9	3,250	40	60
Oct 20	S-28	48	12	0.45	20	0.9	6	15	0	4.5	0.15	20	14.5	8	8	8.8	3,200	76	24
			13	0.45	21	1.0	6	15	0	4.5	0.15	20	14.5	5.5	5.5	6.2	2,250	49	51
			12	0.45	20	1.55	6	15	0	4.5	0.20	20	14.5	4.8	4.8	6.0	2,150	38	62
	</																		

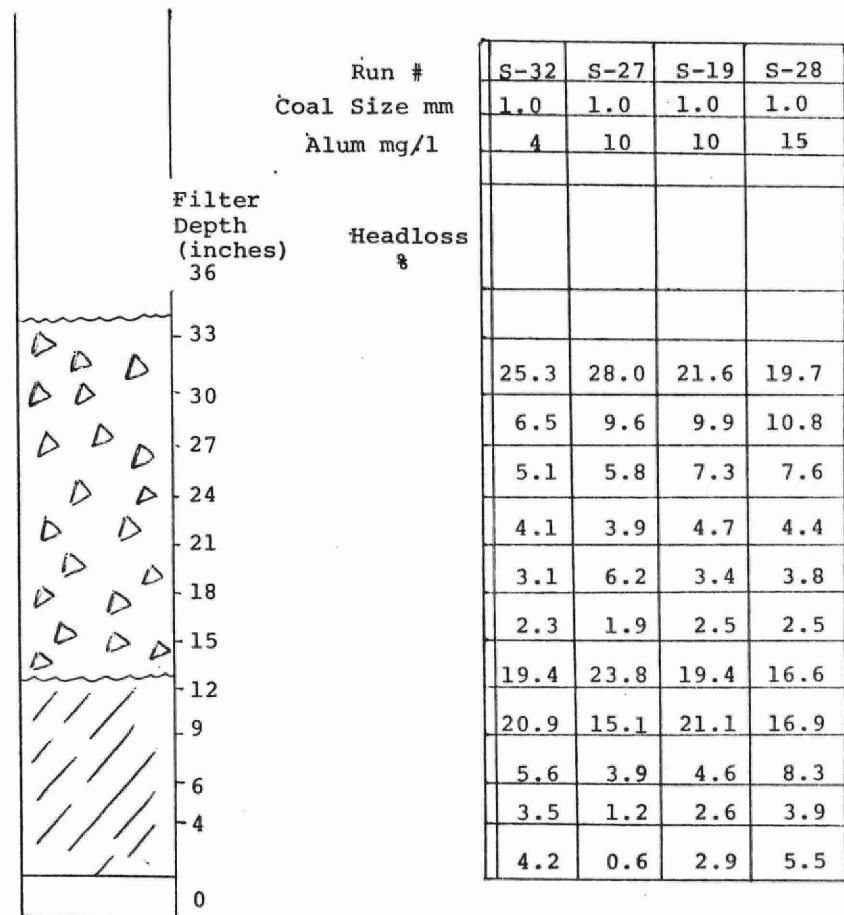
## Appendix 10

## HEADLOSS DISTRIBUTION RESULTS

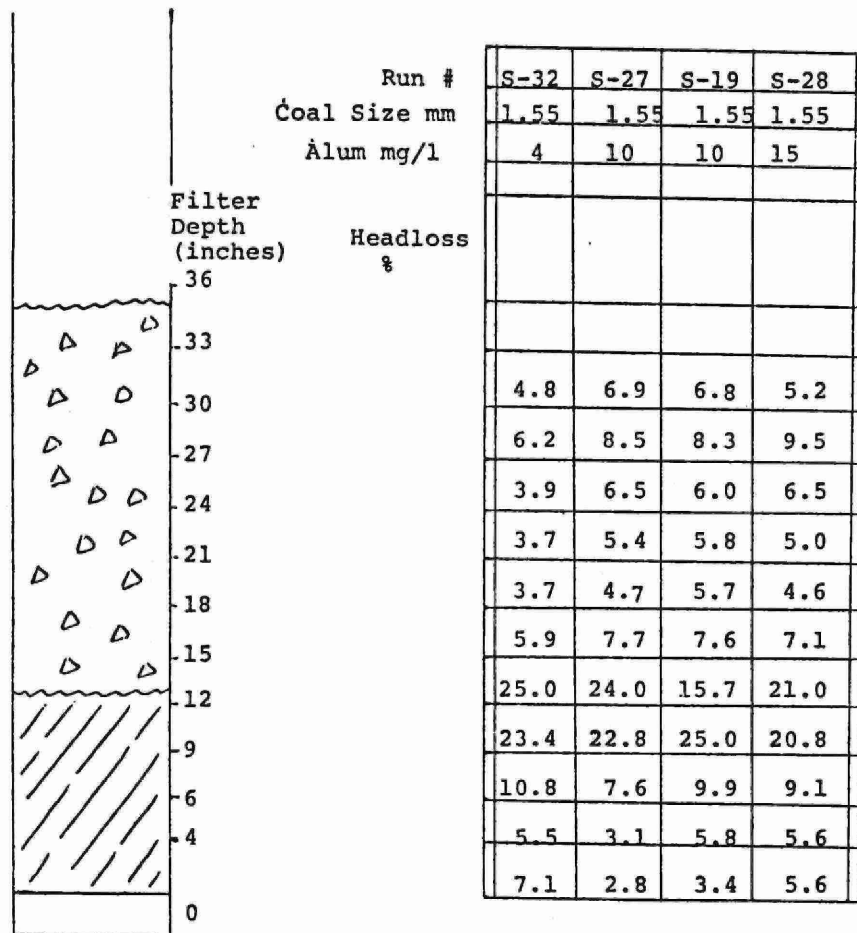


## Appendix 10

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS





Appendix 11

The Influence of Low Algae Levels  
on  
Filter Performance

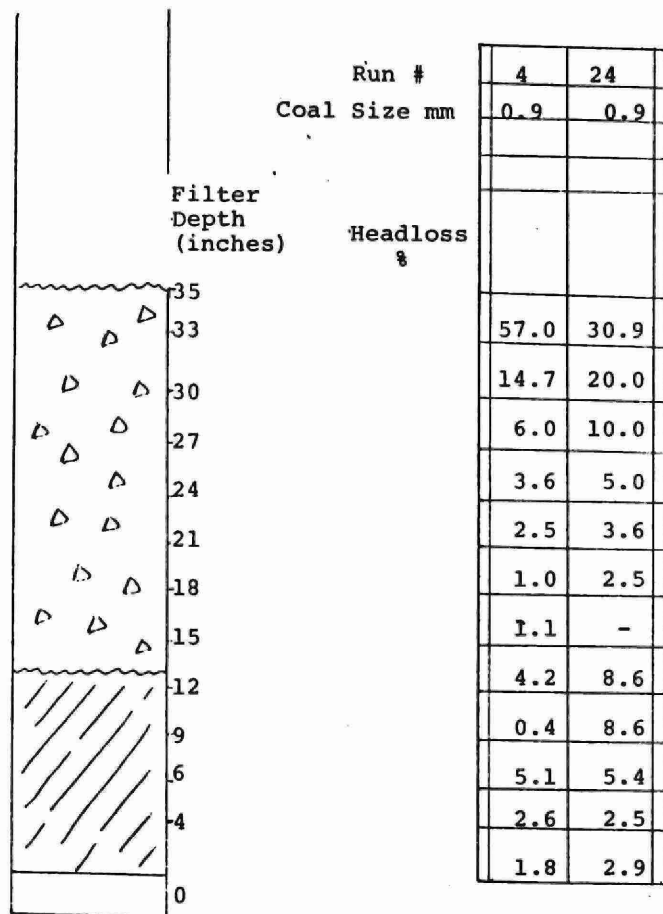
May 28, 1973  
July 16, 1973

## DIRECT FILTRATION

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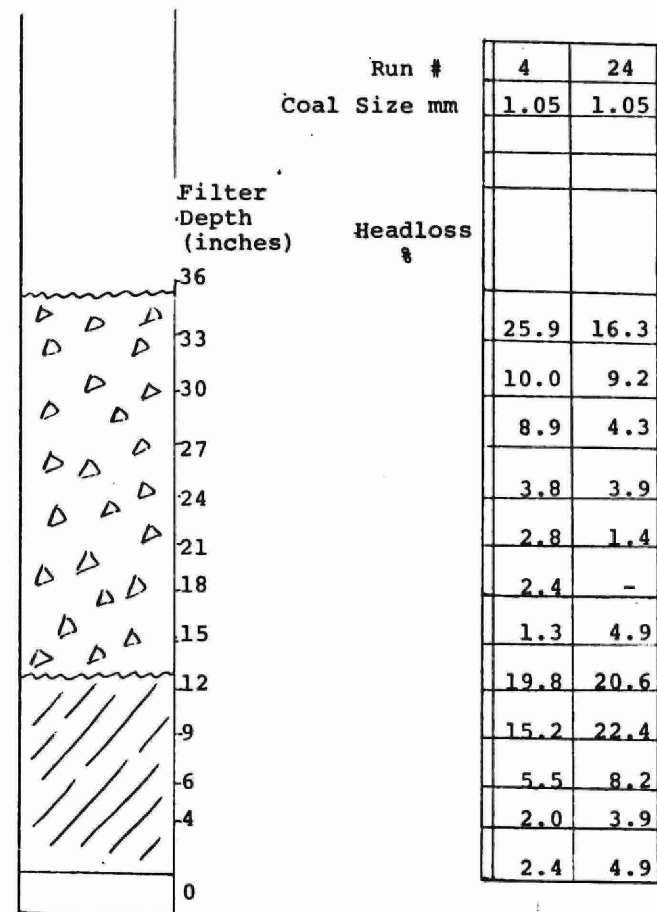
# Appendix 11

## HEADLOSS DISTRIBUTION RESULTS

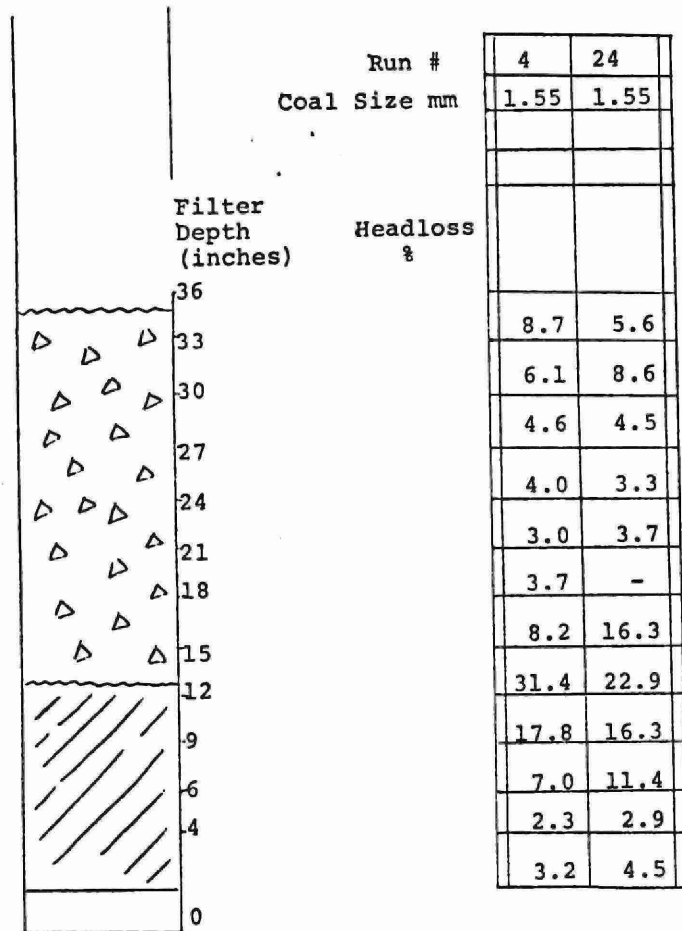


# Appendix 11

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 12

Ferric Chloride

Oct. 24, 1973  
Oct. 23, 1973  
Oct. 22, 1973

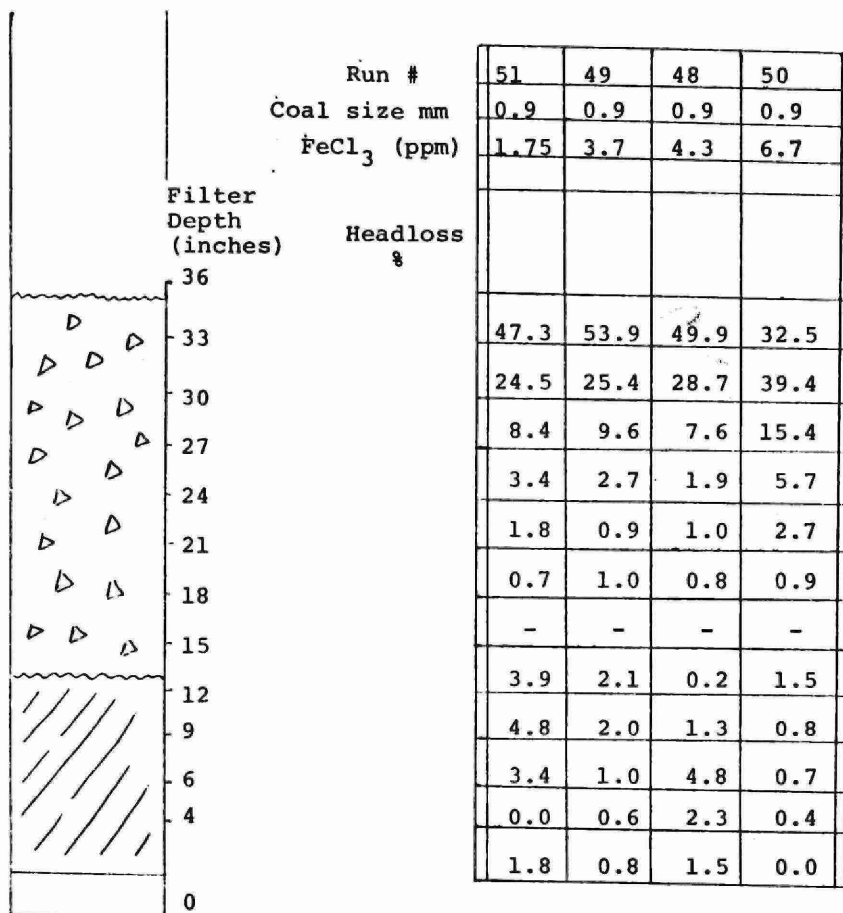
## APPENDIX 12

## DIRECT FILTRATION

MOE 08-114 6-74

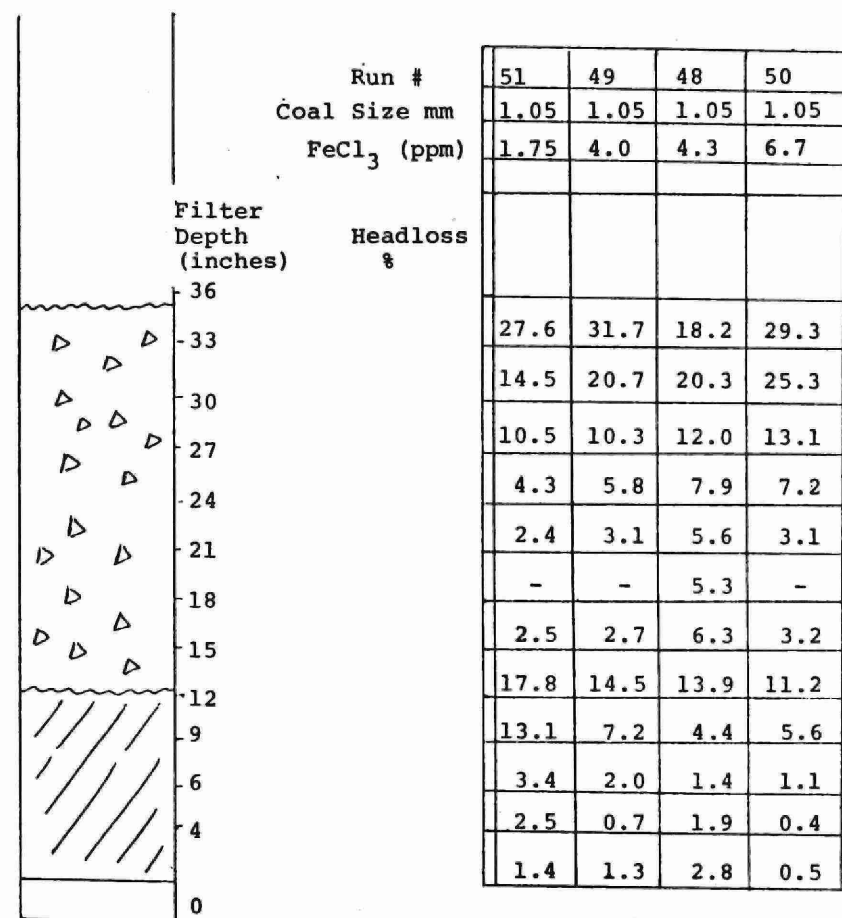
# Appendix 12

## HEADLOSS DISTRIBUTION RESULTS

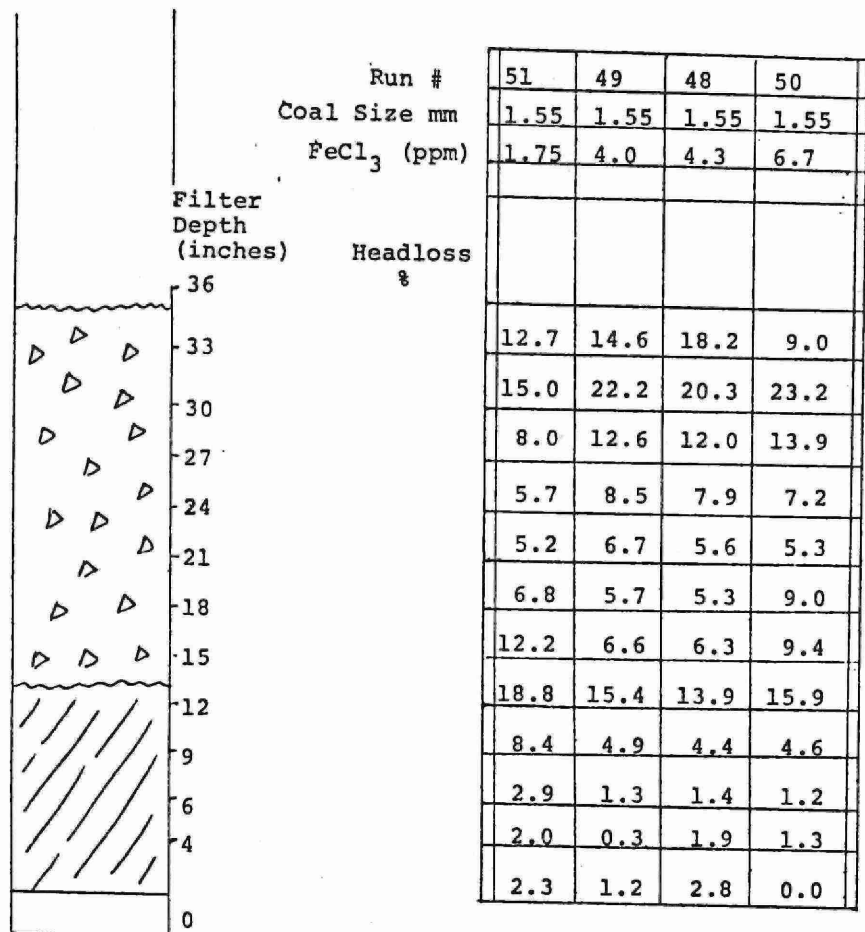


# Appendix 12

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS





APPENDIX 13

Cationic Polymers

as

Primary Coagulants

July 4, 1973  
July 19, 1973  
July 24, 1973  
Aug. 29, 1973  
Sept. 3, 1973



## APPENDIX 13

## DIRECT FILTRATION

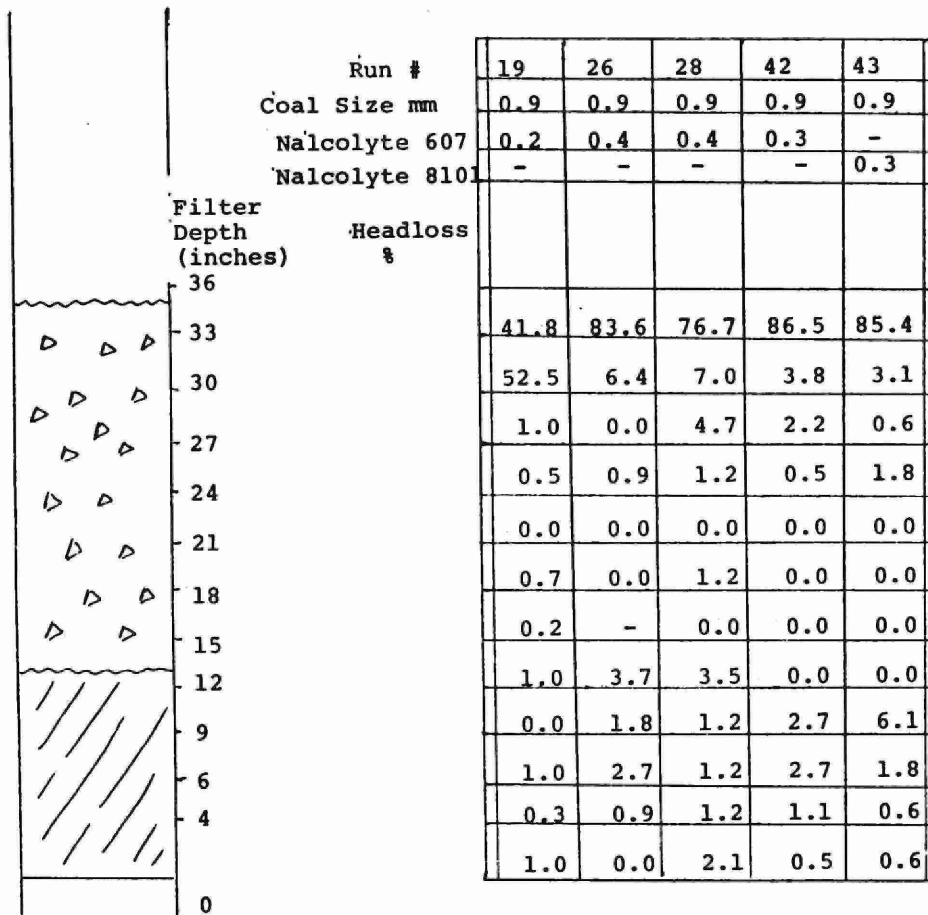
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
July 4	19	53	13	0.45	22	0.9	4	0	0.2	1.3	0.43	20	14.5	6.1	-	50	12,000	97	3
			13	0.45	22	1.05	4	0	0.2	1.3	0.5	20	14.5	3	-	50	12,000	84	16
			13	0.45	22	1.55	4	0	0.2	1.3	0.5	20	14.5	2.1	-	50	12,000	67	33
July 19	26	65	13	0.45	22	0.9	4	0	0.4	1.7	0.8	20	14.5	2.0	-	23.5	5,650	91	9
			13	0.45	22	1.05	4	0	0.4	1.7	0.9	20	14.5	1.5	-	23.5	5,650	58	42
			13	0.45	22	1.55	4	0	0.4	1.7	0.9	20	14.5	1.4	-	23.5	5,650	44	56'
July 24	28	68	13	0.45	22	0.9	4	0	0.4	1.8	0.6	20	18	1.3	-	73	17,500	91	9
			13	0.45	22	1.05	4	0	0.4	1.8	0.6	20	18	1.2	-	73	17,500	75	25
			13	0.45	22	1.55	4	0	0.4	1.8	0.65	20	18	0.8	-	73	17,500	61	39
Aug 29	42	70	13	0.45	22	0.9	4	0	0.2-0.4	0.8	0.45	550	11	2.6	-	43.5	10,450	93	7
			13	0.45	22	1.05	4	0	0.2-0.4	0.8	0.45	550	11	1.6	-	43.5	10,450	82	18
Sept. 3	43	70	13	0.45	22	0.9	4	0	**0.3	1.1	0.48	20	18	2.3	-	21	5,050	91	9
			13	0.45	22	1.05	4	0	**0.3	1.1	0.45	20	18	1.5	-	21	5,050	84	16
			13	0.45	22	1.55	4	0	**0.3	1.1	0.50	20	18	1.5	-	21	5,050	74	26
										* Natural									
										** Nalcolyte 8101									

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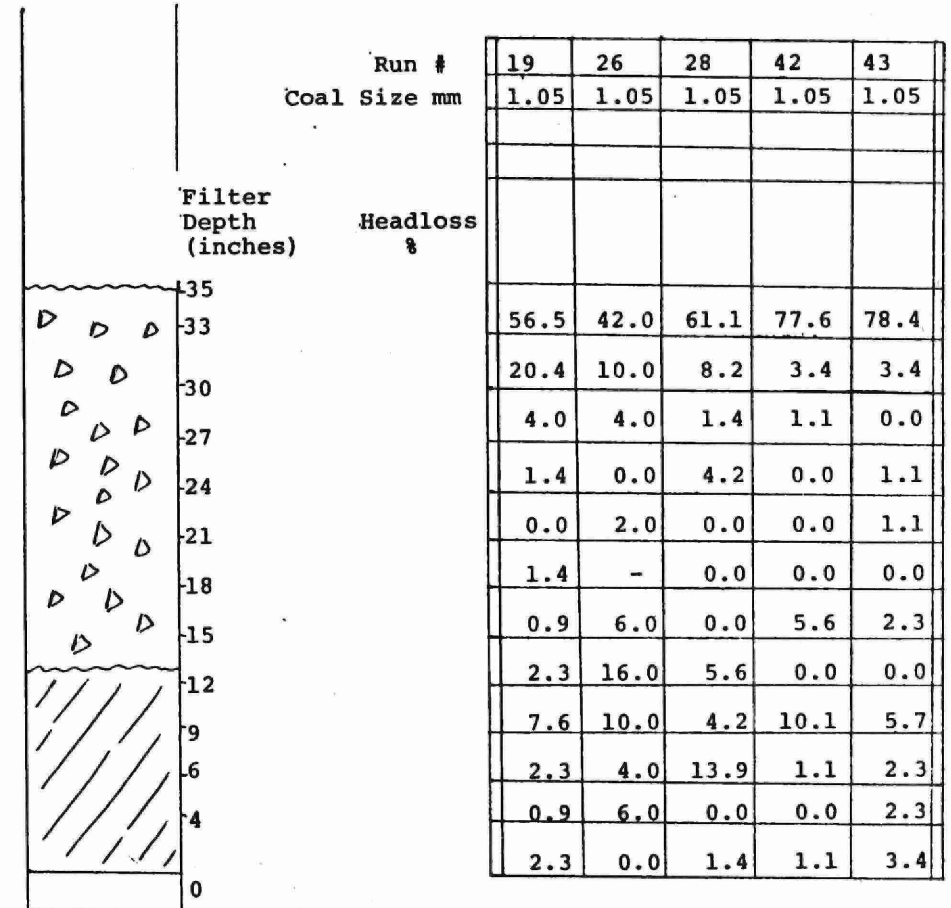
## Appendix 13

## HEADLOSS DISTRIBUTION RESULTS



## Appendix 13

## HEADLOSS DISTRIBUTION RESULTS





APPENDIX 14

Flash Mix Study

Aug. 18, 1973

Aug. 14, 1973

Aug. 20, 1973

Aug. 21, 1973

APPENDIX 14

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution			
			Sand		Coal			Alum ppm	Poly ppm	Raw FTU	Eff. FTU	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %		
			Depth in.	Eff. mm	Depth in.	Eff. mm															
Aug 18	37	67	13	0.45	22	0.9	6	6	0	1.5*	0.18	20	14.5	8	-	23.5	8,450	81	19		
			13	0.45	22	1.05	6	6	0	1.5	0.20	20	14.5	8	-	27	9,700	54	46		
			13	0.45	22	1.55	6	6	0	1.5	0.20	20	14.5	8	-	29	10,450	40	60		
Aug 14	35	67	13	0.45	22	0.9	6	5.5	0	1.5*	0.16	20	14.5	8	-	24	8,650	83	17		
			13	0.45	22	1.05	6	5.5	0	1.5	0.20	20	14.5	8	-	29	10,450	56	44		
			13	0.45	22	1.55	6	5.5	0	1.5	0.16	20	14.5	8	-	31	11,150	39	61		
Aug 20	38	71	13	0.45	22	0.9	4	10	0	12**	0.12	20	18	8	-	19	6,850	93	7		
			13	0.45	22	1.05	4	10	0	12	0.17	20	18	8	-	23	8,300	62	38		
			13	0.45	22	1.55	4	10	0	12	0.12	20	18	8	-	23.5	8,450	43	57		
Aug 21	39	71	13	0.45	22	0.9	4	10	0	12**	0.23	20	18	8	-	19	6,850	90	10		
			13	0.45	22	1.05	4	10	0	12	0.23	20	18	8	-	25	9,000	69	31		
			13	0.45	22	1.55	4	10	0	12	0.23	20	18	8	-	24.5	8,800	40	60		
										* natural											
										** turbidity added to raw water											

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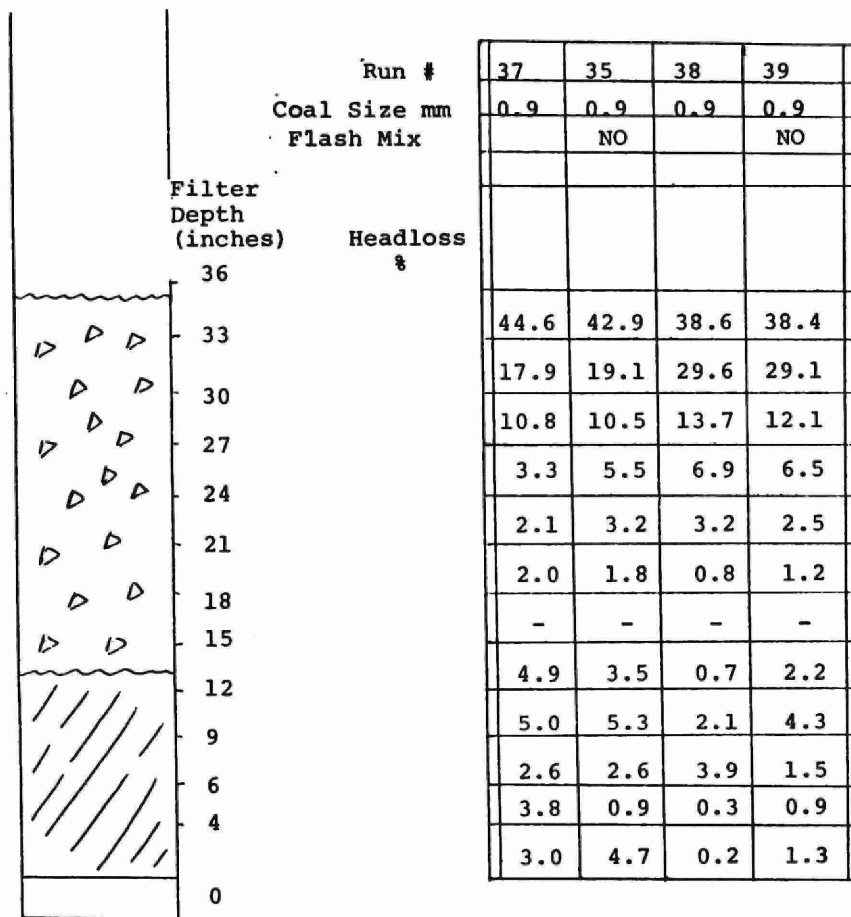
-55-

\* natural

\*\* turbidity added to raw water

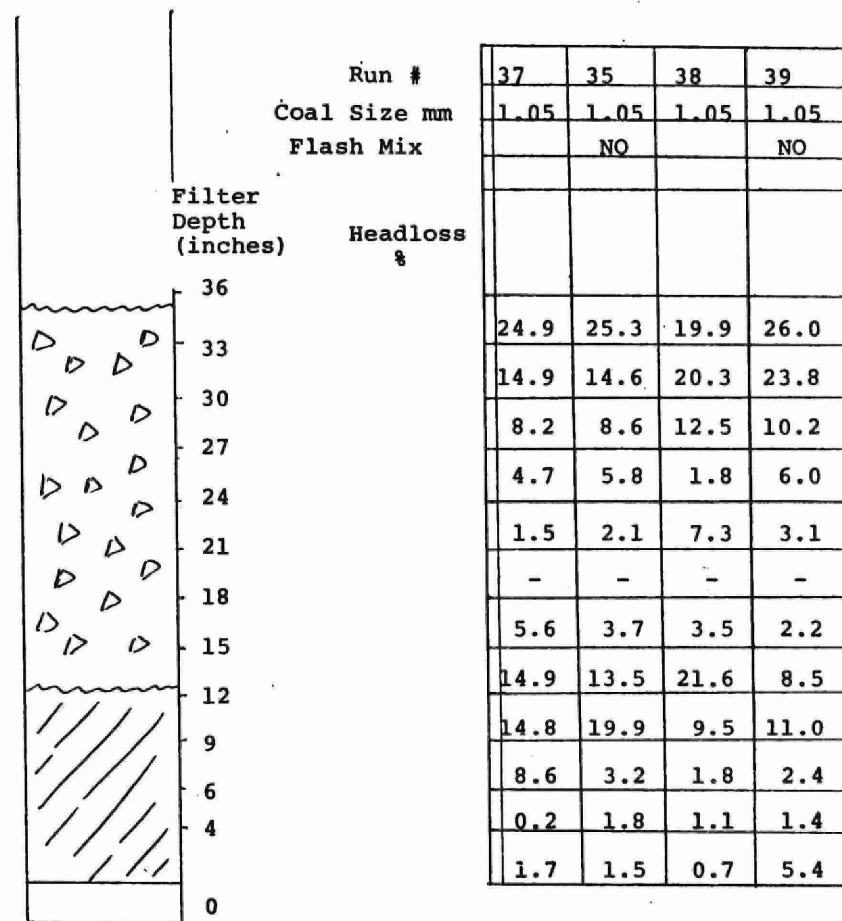
## Appendix 14

## HEADLOSS DISTRIBUTION RESULTS

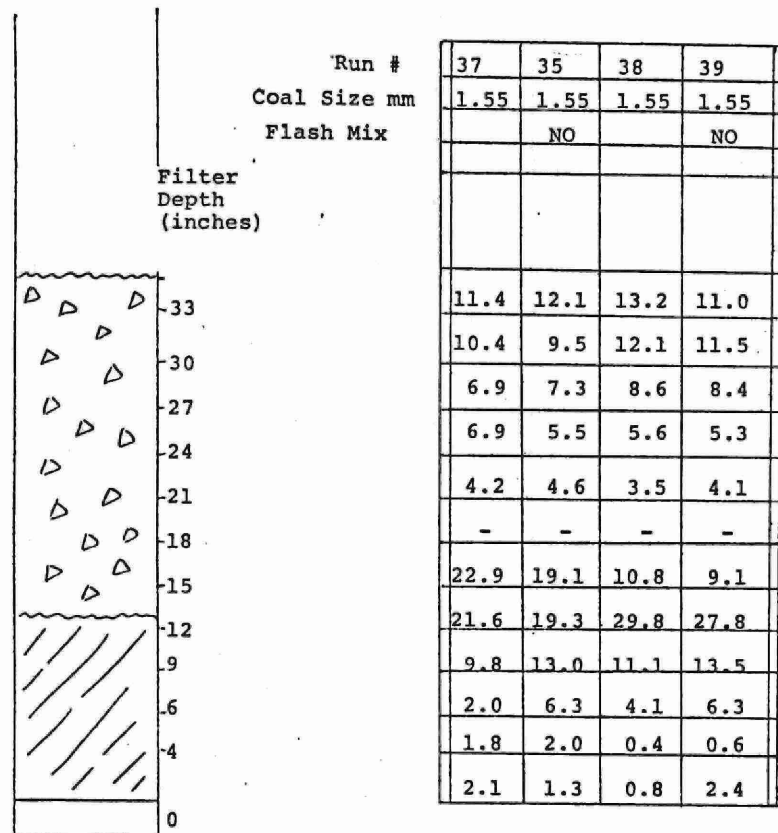


## Appendix 14

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS





APPENDIX 15

Flocculation Velocity  
Gradient

Oct. 2, 1972  
Oct. 5, 1972  
Oct. 3, 1972  
Oct. 10, 1972



## APPENDIX 15

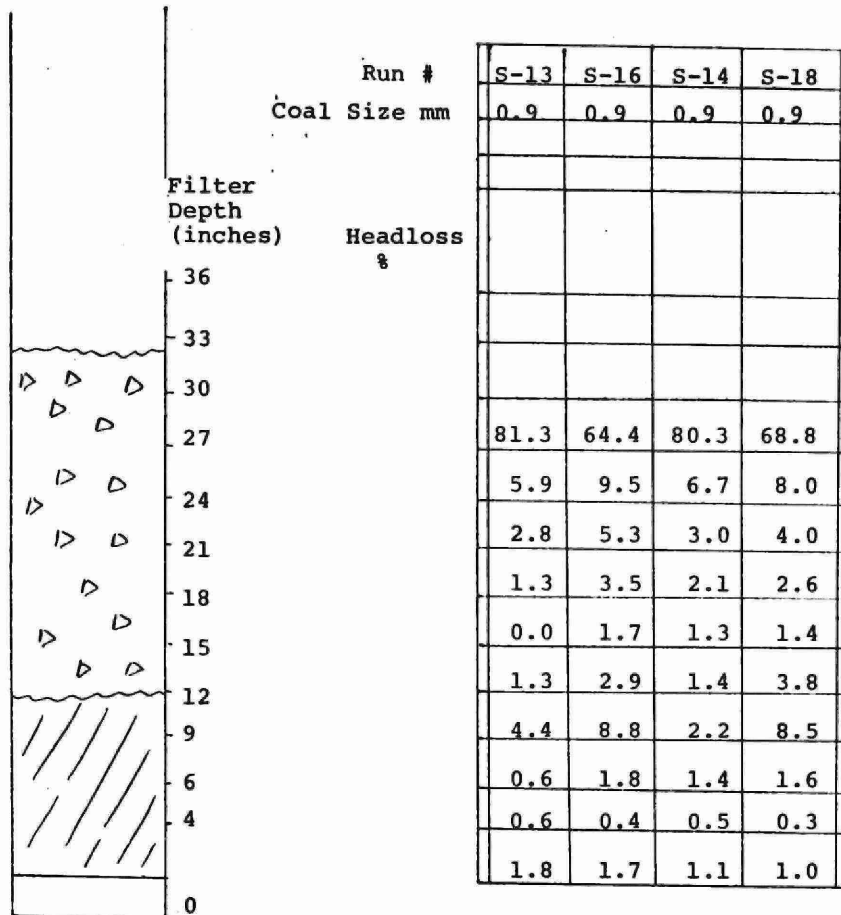
## DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Oct 2	S-13	60	12	0.45	20	0.9	6	10	0	0.8	0.17	20	14.5	8	-	9	3250	91	9
			13	0.45	21	1.05	6	10	0	0.8	0.18	20	14.5	8	-	13	4700	72	28
			12	0.45	20	1.55	6	10	0	0.8	0.18	20	14.5	8	-	13	4700	42	58
Oct 5	S-16	60	12	0.45	20	0.9	6	10	0	0.7	0.10	50	14	8	-	10.5	3800	84	16
			13	0.45	21	1.05	6	10	0	0.7	0.10	50	14	8	-	13	4700	52	48
			12	0.45	20	1.55	6	10	0	0.7	0.10	50	14	8	-	12.5	4500	33	67
Oct 3	S-14	60	12	0.45	20	0.9	6	15	0	0.8	0.10	20	14.5	8	-	7	2500	93	7
			13	0.45	21	1.05	6	15	0	0.8	0.11	20	14.5	8	-	9.7	3500	62	38
			12	0.45	20	1.55	6	15	0	0.8	0.13	20	14.5	8	-	9	3250	42	58
Oct 10	S-18	57	12	0.45	20	0.9	6	15	0	1.5	0.10	50	14.5	8	-	7	2500	85	15
			13	0.45	21	1.05	6	15	0	1.5	0.10	50	14.5	8	-	9	3250	54	46
			12	0.45	20	1.55	6	15	0	1.5	0.10	50	14.5	7	7	8	2900	34	66

\*Natural

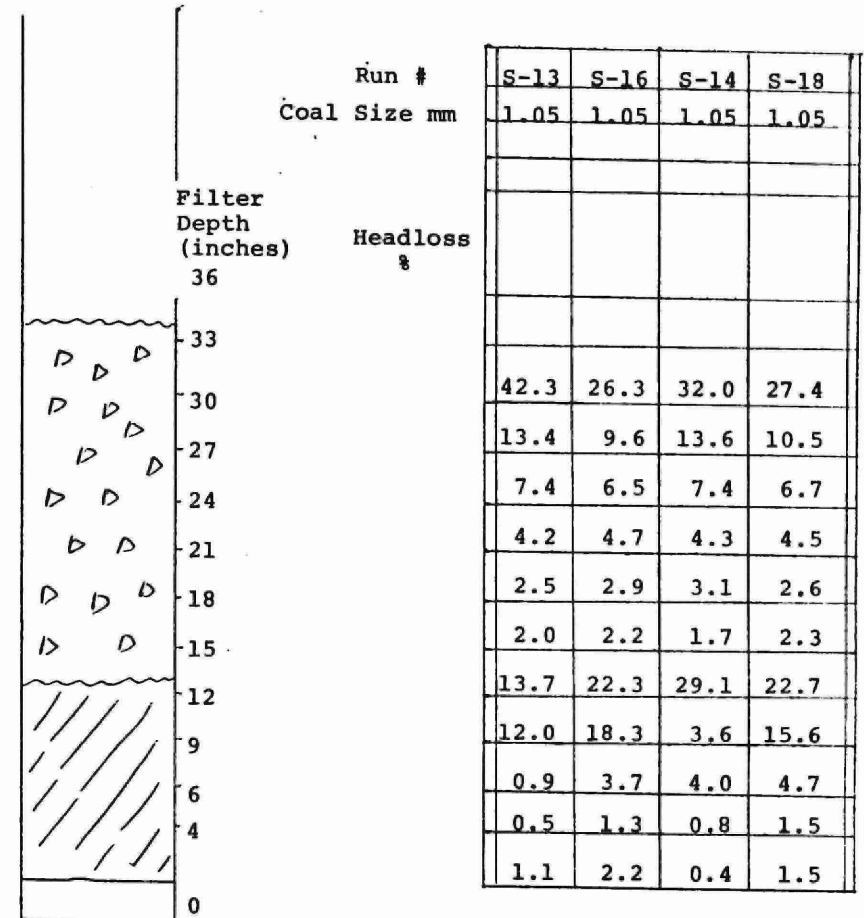
Appendix 15

HEADLOSS DISTRIBUTION RESULTS

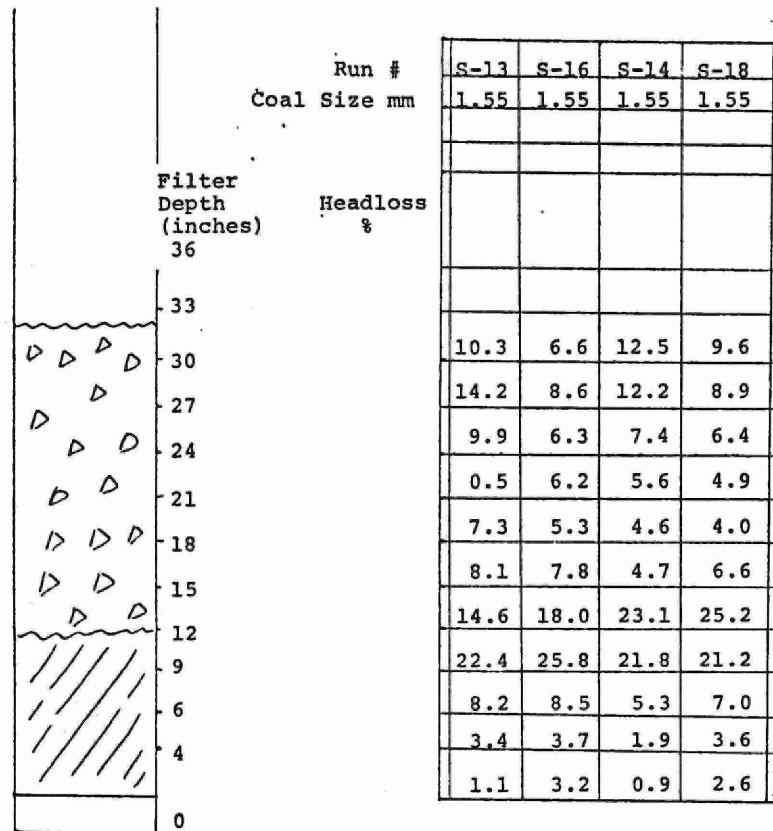


Appendix 15

HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 16

Flocculation Velocity  
Gradient

Oct. 29, 1974  
Oct. 30, 1974  
Oct. 31, 1974

## APPENDIX 16

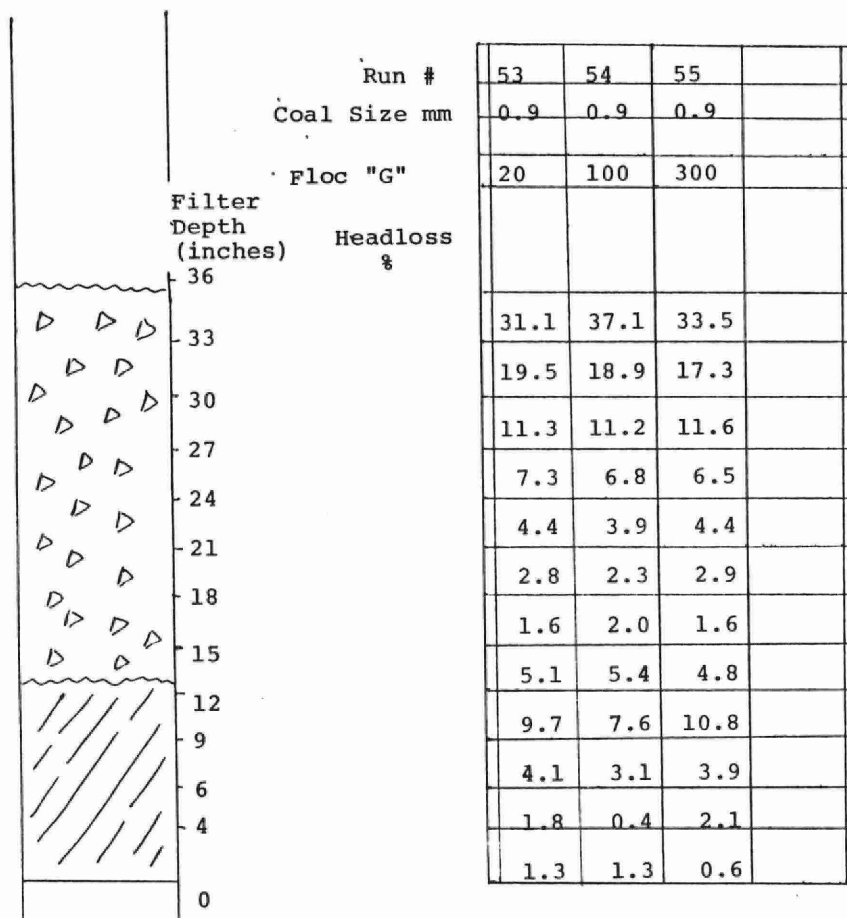
## DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Oct 29	53	55	13	0.45	22	0.9	4	12	0	16	0.14	20	14.5	8	-	16.0	3850	78	22
			13	0.45	22	1.05	4	12	0	16	0.15	20	14.5	6	6	14.5	3500	59	41
			13	0.45	22	1.55	4	12	0	16	0.13	20	14.5	6	6	13.5	3250	34	66
Oct 30	54	55	13	0.45	22	0.9	4	12	0	12.5	0.14	100	14.5	8	-	15	3600	82	18
			13	0.45	22	1.05	4	12	0	12.5	0.13	100	14.5	6	6	16.5	3950	65	35
			13	0.45	22	1.55	4	12	0	12.5	0.15	100	14.5	6	6	13.5	3250	32	68
Oct 31	55	55	13	0.45	22	0.9	4	12	0	14	0.14	300	14.5	7.3	7.3	17.0	4100	78	22
			13	0.45	22	1.05	4	12	0	14	0.15	300	14.5	4.5	4.5	13	3100	56	44
			13	0.45	22	1.55	4	12	0	14	0.15	300	14.5	4.5	4.5	11.5	2750	29	71

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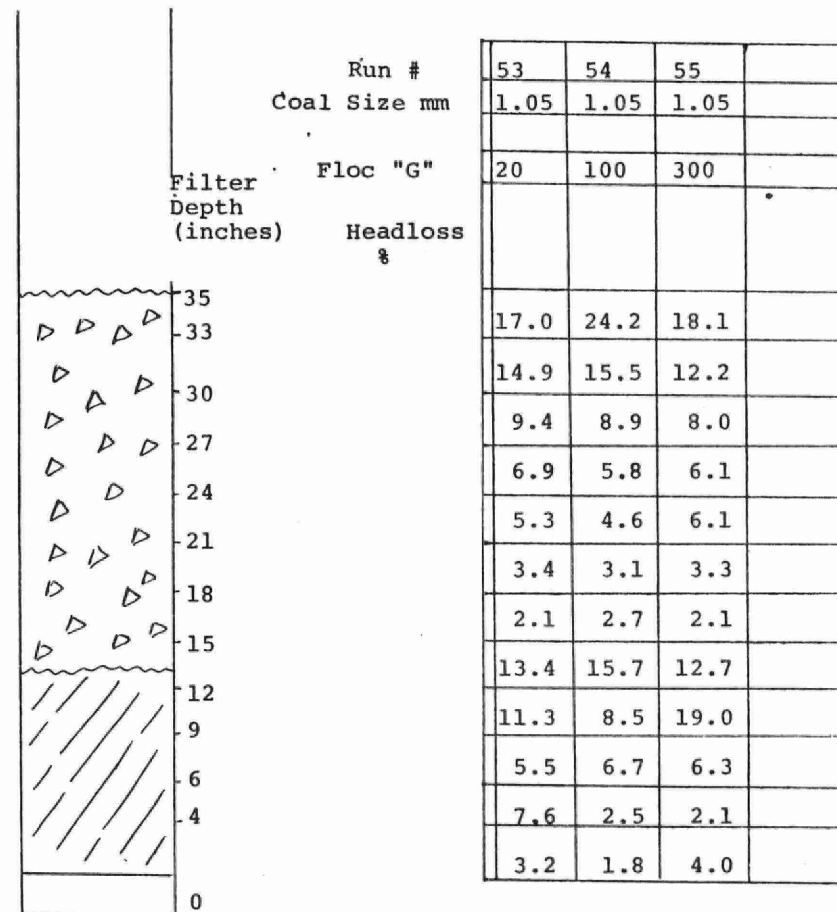
Appendix 16

HEADLOSS DISTRIBUTION RESULTS



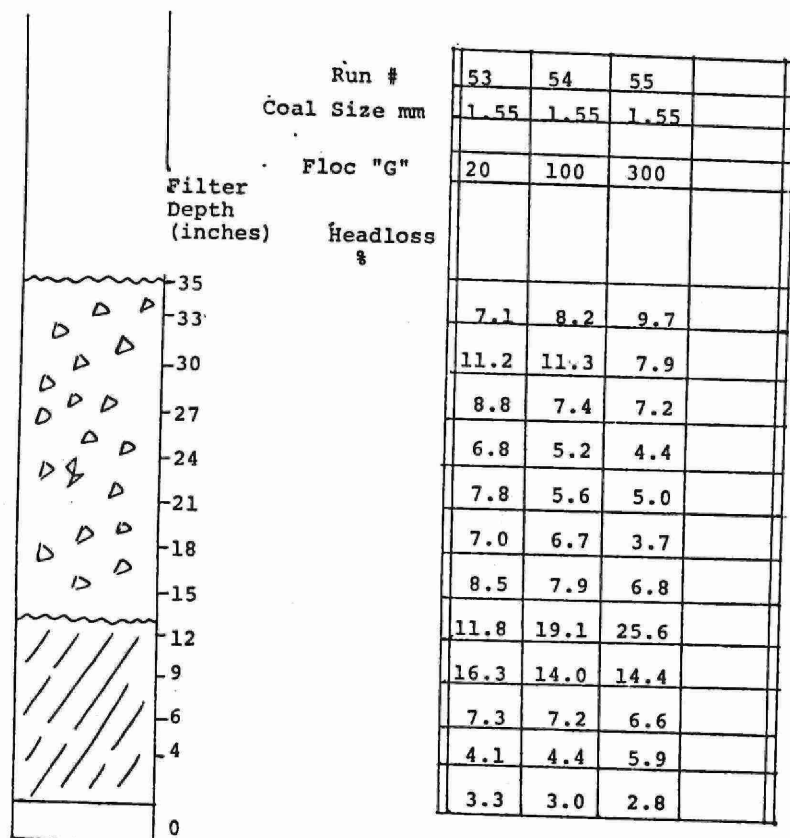
Appendix 16

HEADLOSS DISTRIBUTION RESULTS



Appendix 16

HEADLOSS DISTRIBUTION RESULTS





APPENDIX 17

Flocculation Velocity Gradient

Nov. 2, 1974  
Nov. 3, 1974  
Nov. 5, 1974  
Nov. 7, 1974



## APPENDIX 17

## DIRECT FILTRATION

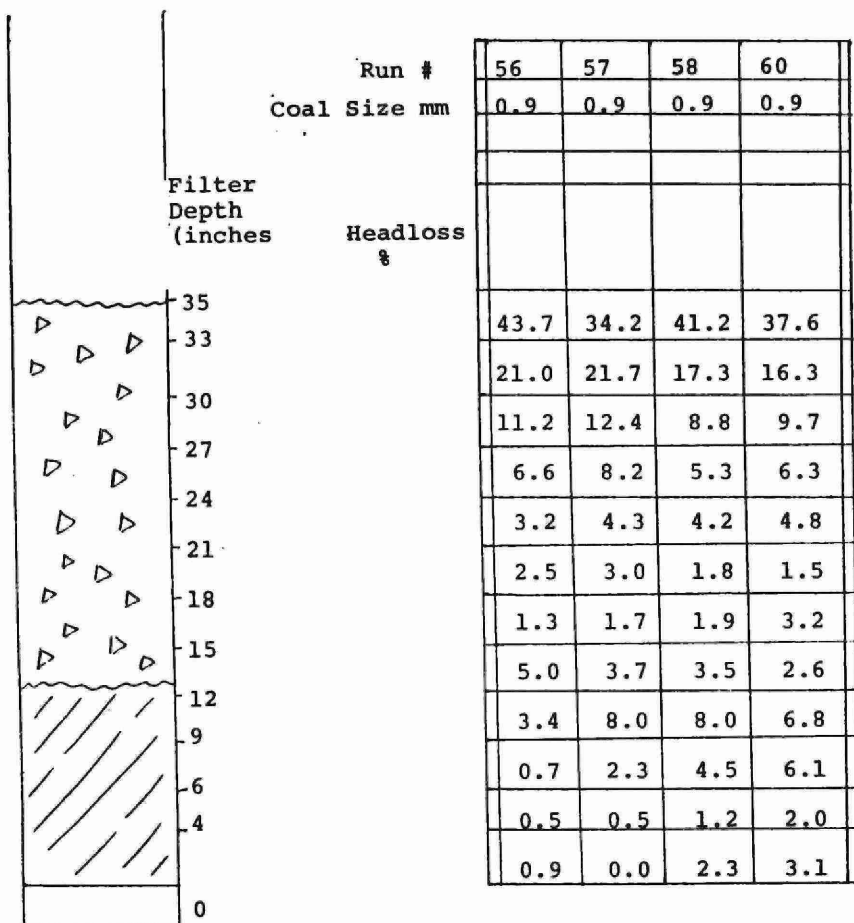
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum ppm	Poly ppm	Raw FTU *	Eff. FTU	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm													
Nov 2	56	55	13	0.45	22	0.9	4	12	0	13	0.16	20	4.5	8	-	13.4	3200	90	10
			13	0.45	22	1.05	4	12	0	13	0.16	20	4.5	8	-	16.8	4050	59	41
			13	0.45	22	1.55	4	12	0	13	0.16	20	4.5	8	-	15.5	3700	35	65
Nov 3	57	55	13	0.45	22	0.9	4	12	0	14	0.16	300	4.5	8	-	13.0	3100	86	14
			13	0.45	22	1.05	4	12	0	14	0.16	300	4.5	7.5	7.5	17.3	4150	62	39
			13	0.45	22	1.55	4	12	0	14	0.16	300	4.5	7.2	7.2	15.5	3700	32	68
Nov 5	58	53	13	0.45	22	0.9	4	12	0	15	0.16	20	28	7	7	14.0	3350	81	19
			13	0.45	22	1.05	4	12	0	15	0.17	20	28	4.7	4.7	11.5	2750	58	42
			13	0.45	22	1.55	4	12	0	15	0.16	20	28	4.5	4.5	10.0	2400	29	71
Nov 7	60	50	13	0.45	22	0.9	4	12	0	15	0.14	300	28	6	6	13.0	3100	79	21
			13	0.45	22	1.05	4	12	0	15	0.14	300	28	3.6	3.6	12.0	2900	56	44
			13	0.45	22	1.55	4	12	0	15	0.14	300	28	3.7	3.7	9.5	2300	70	30
* Turbidity added to raw																			

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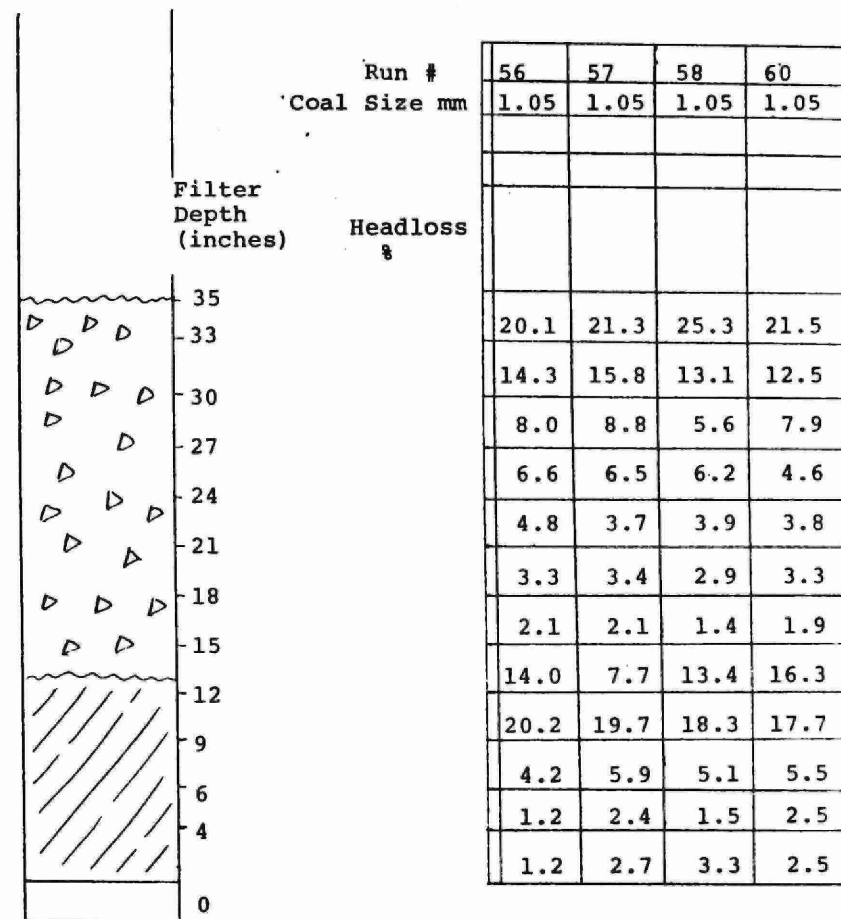
# Appendix 17

## HEADLOSS DISTRIBUTION RESULTS



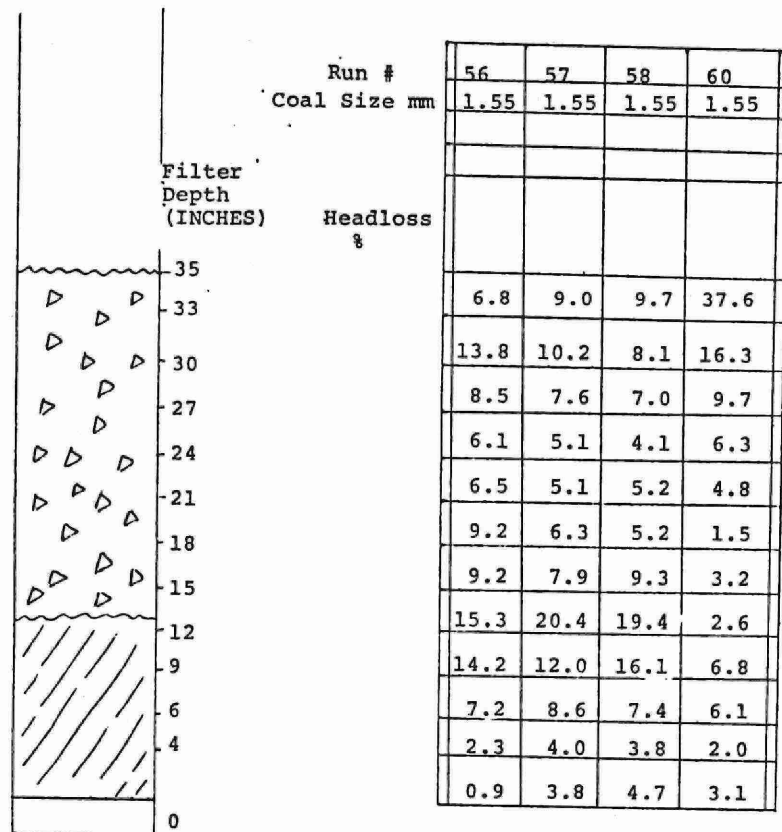
# Appendix 17

## HEADLOSS DISTRIBUTION RESULTS



Appendix 17

HEADLOSS DISTRIBUTION RESULTS



APPENDIX 18

Flocculation Velocity Gradient  
Low Temperature

Jan. 28, 1974  
Jan. 29, 1974

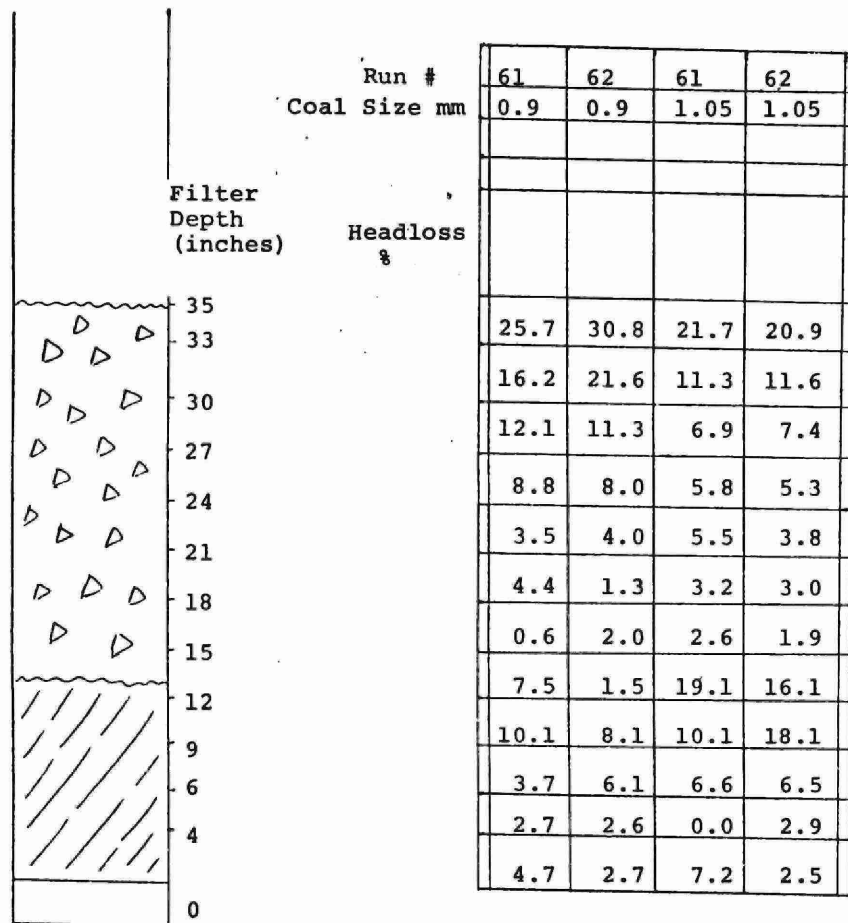


## DIRECT FILTRATION

\* Turbidity added to raw

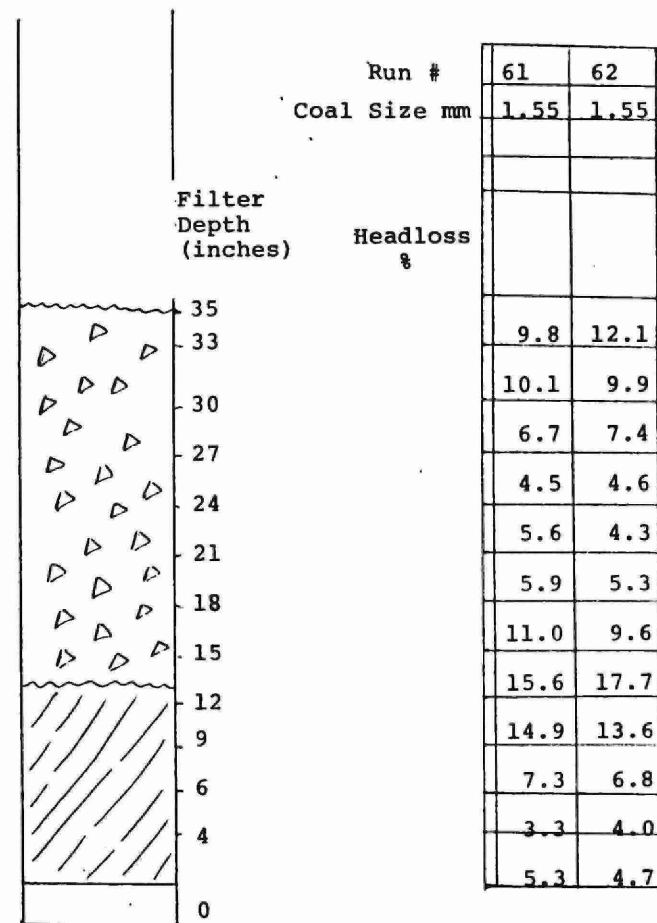
Appendix 18

HEADLOSS DISTRIBUTION RESULTS



Appendix 18

HEADLOSS DISTRIBUTION RESULTS



APPENDIX 19

Flocculation Velocity Gradient

Oct. 4, 1972

Oct. 6, 1972

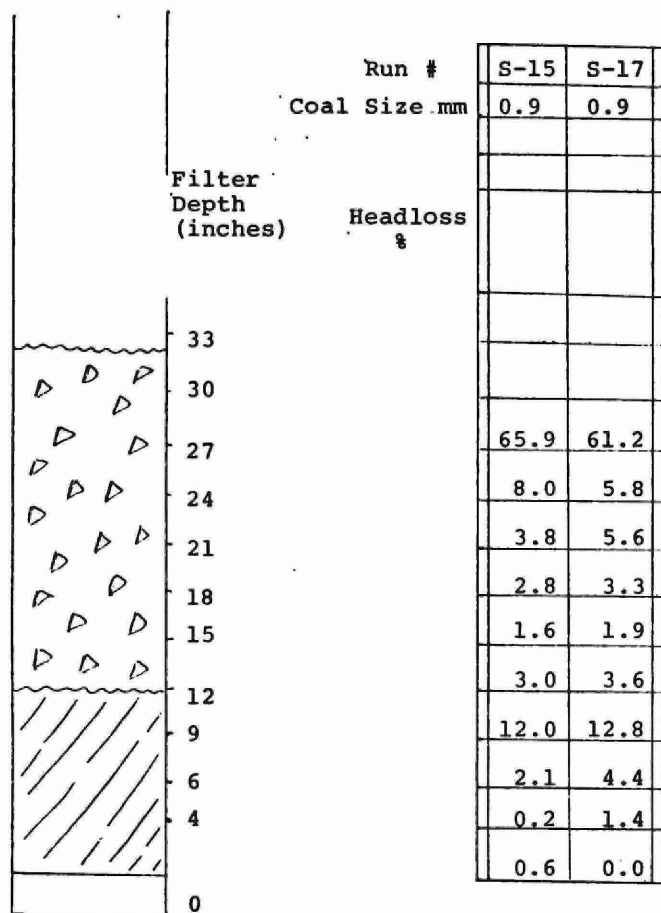


## DIRECT FILTRATION

\* Natural

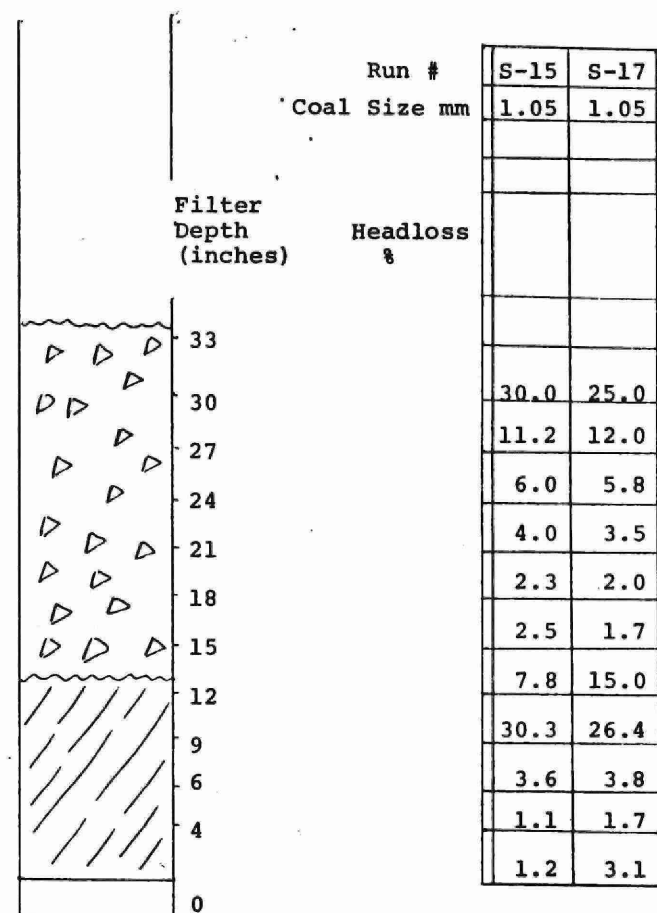
## Appendix 19

## HEADLOSS DISTRIBUTION RESULTS

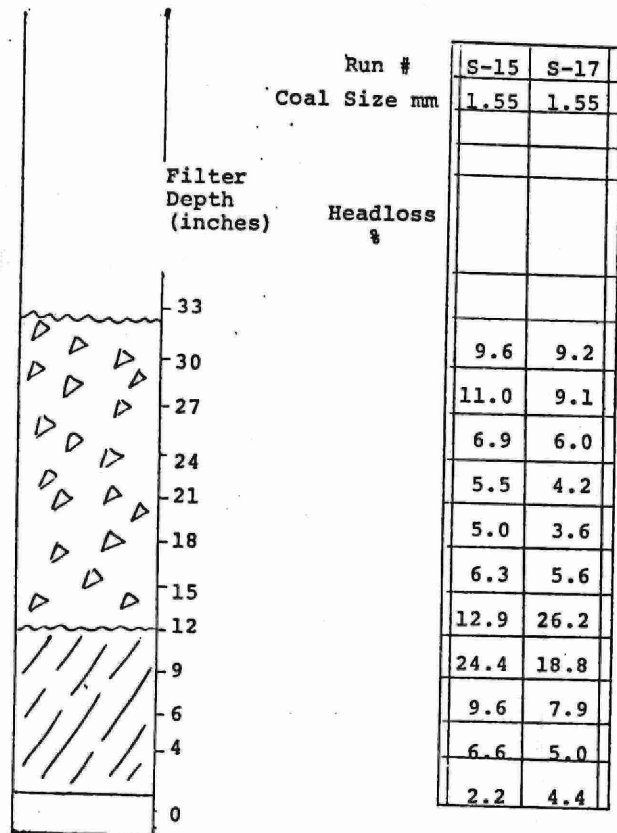


## Appendix 19

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 20

Flocculation Velocity Gradient 1973

June 20, 1973

June 25, 1973

Aug. 18, 1973

Aug. 7, 1973



APPENDIX 20

DIRECT FILTRATION

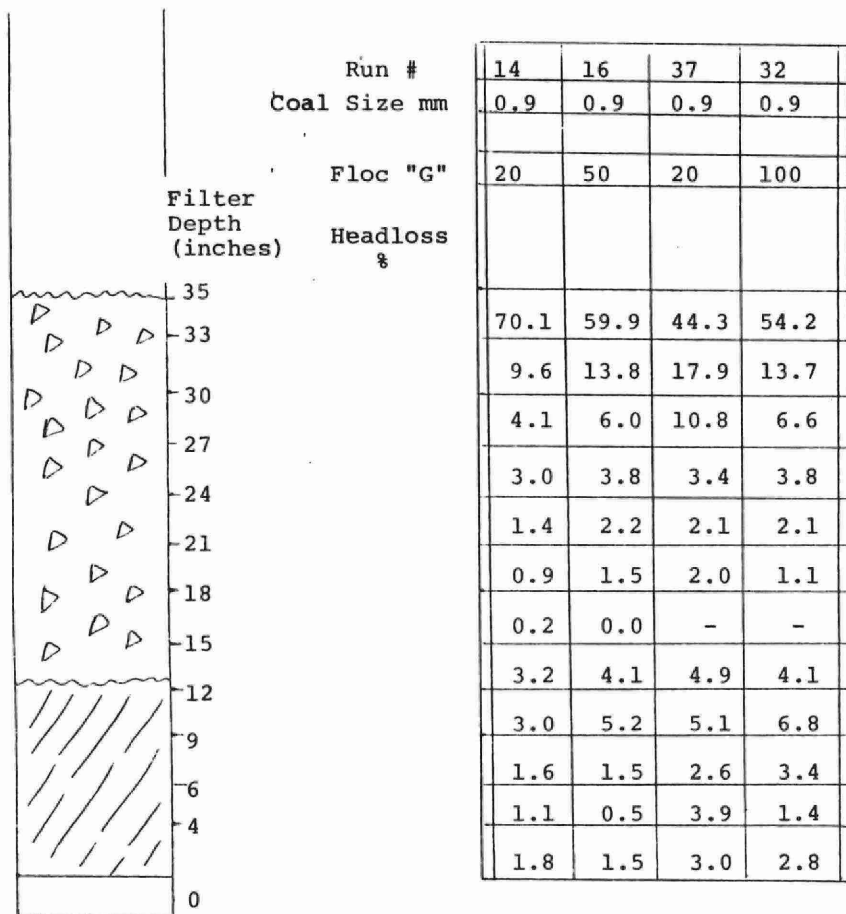
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
June 20	14	50	13	0.45	22	0.9	4	6.2	0	1.5	0.16	20	14.5	8	-	21	5050	89	11
			13	0.45	22	1.05	4	6.2	0	1.5	0.17	20	14.5	8	-	39.0	9350	55	45
			13	0.45	22	1.55	4	6.2	0	1.5	0.20	20	14.5	8	5	40	9600	27	73
June 25	16	55	13	0.45	22	0.9	4	6	0	1.2	0.16	50	14.5	8	-	23.5	5650	87	13
			13	0.45	22	1.05	4	6	0	1.2	0.17	50	14.5	8	-	33	7900	56	44
			13	0.45	22	1.55	4	6	0	1.2	0.17	50	14.5	8	6	36.5	8750	33	67
Aug 18	37	67	13	0.45	22	0.9	6	6	0	1.5	0.18	20	14.5	8	-	23.5	8450	81	19
			13	0.45	22	1.05	6	6	0	1.5	0.20	20	14.5	8	-	27	9700	54	46
			13	0.45	22	1.55	6	6	0	1.5	0.20	20	14.5	8	-	29	10,550	39	61
Aug 7	32	68	13	0.45	22	0.9	6	6	0	1.2	0.23	100	14.5	8	-	26.5	9550	82	18
			13	0.45	22	1.05	6	6	0	1.2	0.23	100	14.5	8	-	34	12,250	49	51
			13	0.45	22	1.55	6	6	0	1.2	0.23	100	14.5	8	-	34	12,250	34	66
										* Natural									

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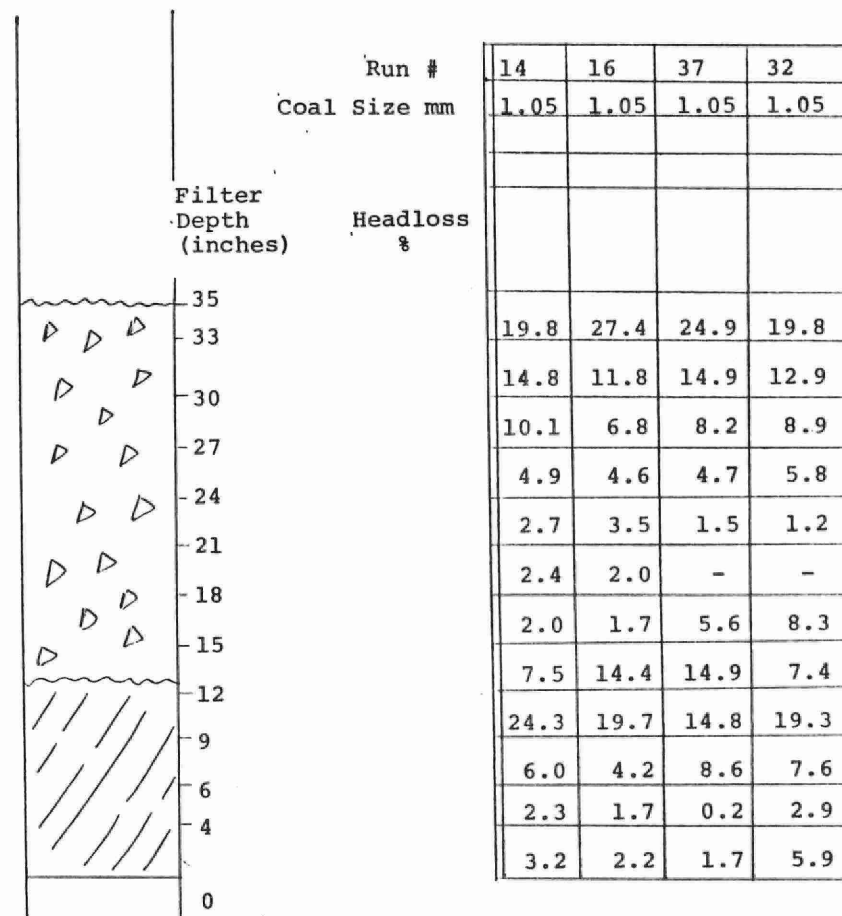
Appendix 20

HEADLOSS DISTRIBUTION RESULTS

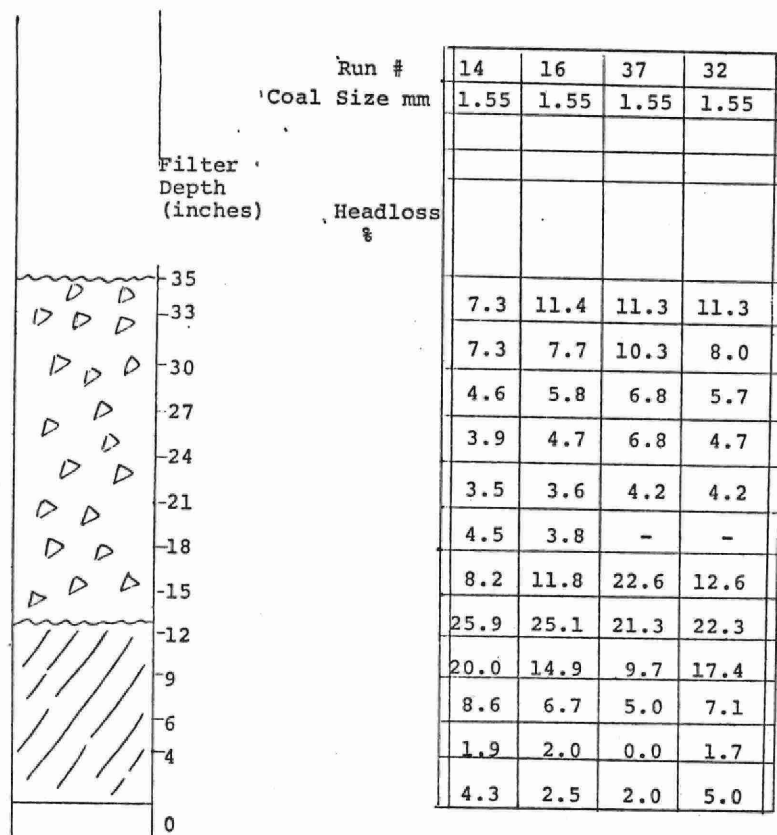


Appendix 20

HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 21

Flocculation Retention Time

Oct. 18, 1972  
Oct. 20, 1972  
Oct. 17, 1972



APPENDIX 21

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Oct 18	S-26	54	12	0.45	20	0.9	6	15	0	7	0.18	20	8	8	-	8.7	3150	79	21
			13	0.45	21	1.0	6	15	0	7	0.18	20	8	8	-	10.0	3600	54	46
			12	0.45	20	1.55	6	15	0	7	0.18	20	8	8	-	9.5	3400	33	67
Oct 20	S-28	48	12	0.45	20	0.9	6	15	0	4.5	0.15	20	14.5	8	8	8.8	3150	76	24
			13	0.45	21	1.0	6	15	0	4.5	0.15	20	14.5	5.5	5.5	6.2	2250	49	51
			12	0.45	20	1.55	6	15	0	4.5	0.20	20	14.5	4.8	4.8	6.0	2150	31	69
Oct 17	S-24	54	12	0.45	20	0.9	6	15	0	19	0.2	20	14.5	5.6	5.6	5.8	2100	78	22
			13	0.45	21	1.0	6	15	0	19	0.21	20	14.5	4.0	4.0	5.2	1850	56	44
			12	0.45	20	1.55	6	15	0	19	0.25	20	14.5	3.0	3.0	3.6	1300	33	67
Oct 17	S-25	54	12	0.45	20	0.9	6	15	0	18	0.19	20	18	4.2	4.2	4.5	1600	69	31
			13	0.45	21	1.0	6	15	0	18	0.19	20	18	3.6	3.6	4.2	1500	51	49
			12	0.45	20	1.55	6	15	0	18	0.23	20	18	2.5	2.5	2.8	1000	40	60
										* Natural									

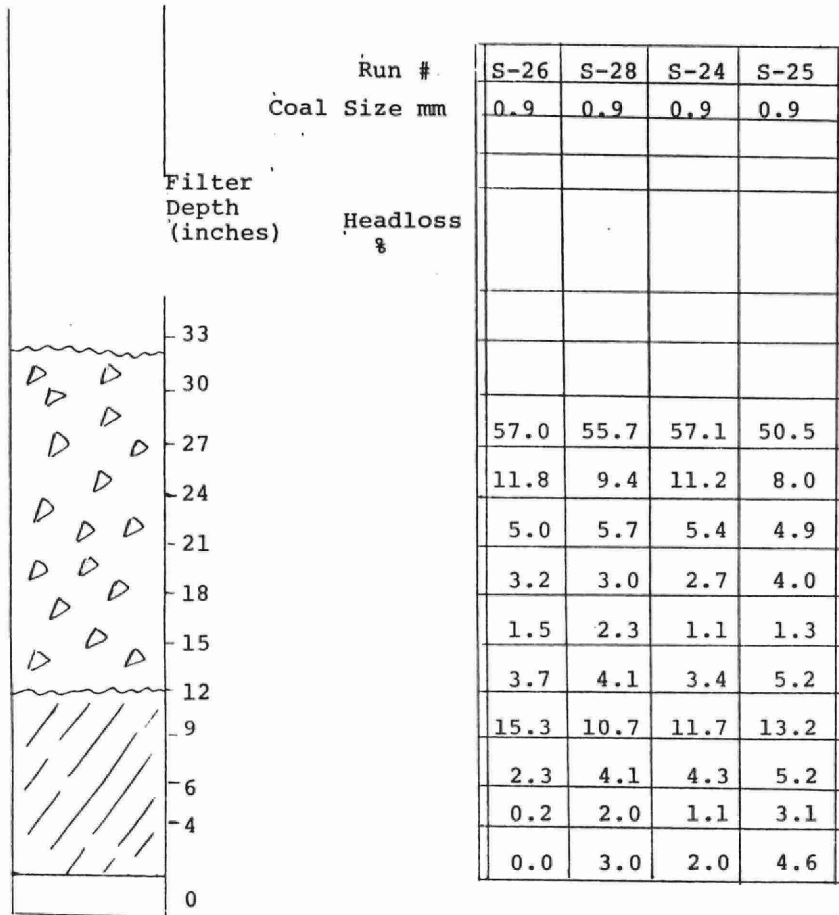
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\* Natural

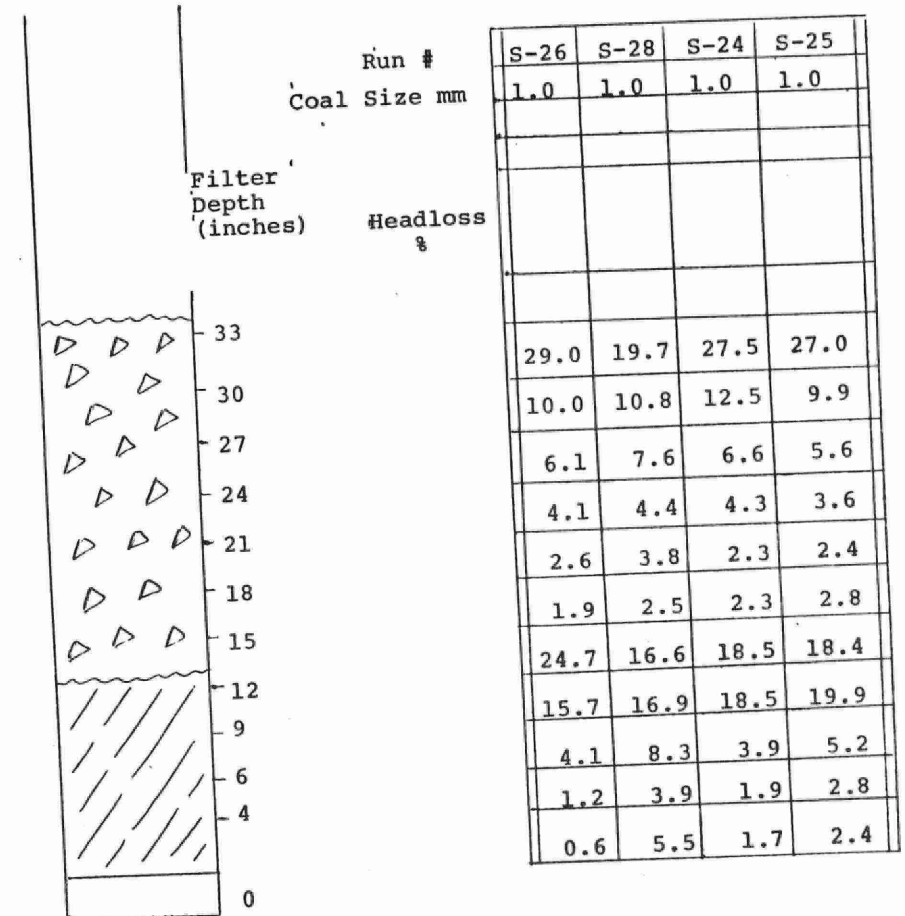
# Appendix 21

## HEADLOSS DISTRIBUTION RESULTS

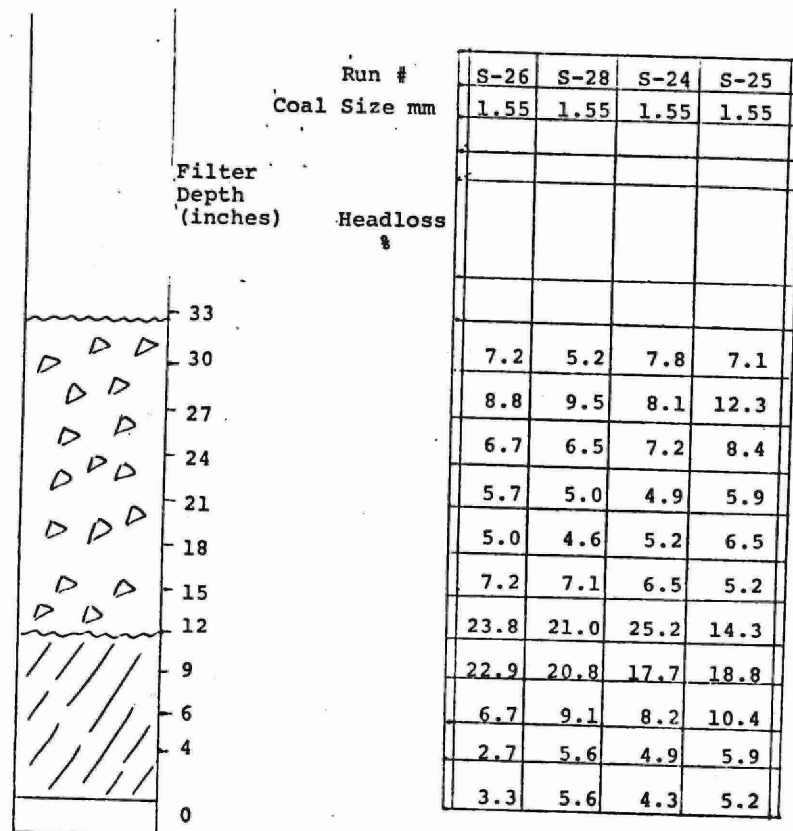


# Appendix 21

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 22

Flocculation Retention Time

Nov. 2, 1973  
Oct. 29, 1973  
Nov. 5, 1973

## APPENDIX 22

## DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum ppm	Poly ppm	Raw FTU *	Eff. FTU	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm													
Nov 2	56	55	13	0.45	22	0.8	4	12	0	13	0.16	20	4.5	8	-	13.4	3200	90	10
			13	0.45	22	1.05	4	12	0	13	0.16	20	4.5	8	-	16.8	4050	59	41
			13	0.45	22	1.55	4	12	0	13	0.16	20	4.5	8	-	15.5	3700	51	49
Oct 29	53	55	13	0.45	22	0.9	4	12	0	16	0.14	20	14.5	8	-	16.0	3850	78	22
			13	0.45	22	1.05	4	12	0	16	0.15	20	14.5	6	6	14.5	3500	59	41
			13	0.45	22	1.55	4	12	0	16	0.13	20	14.5	6	6	13.5	3250	49	51
Nov 5	58	53	13	0.45	22	0.9	4	12	0	15	0.16	20	28	7	7	14.0	3350	81	19
			13	0.45	22	1.05	4	12	0	15	0.17	20	28	4.7	4.7	11.5	2750	58	42
			13	0.45	22	1.55	4	12	0	15	0.16	20	28	4.5	4.5	10.0	2400	39	63

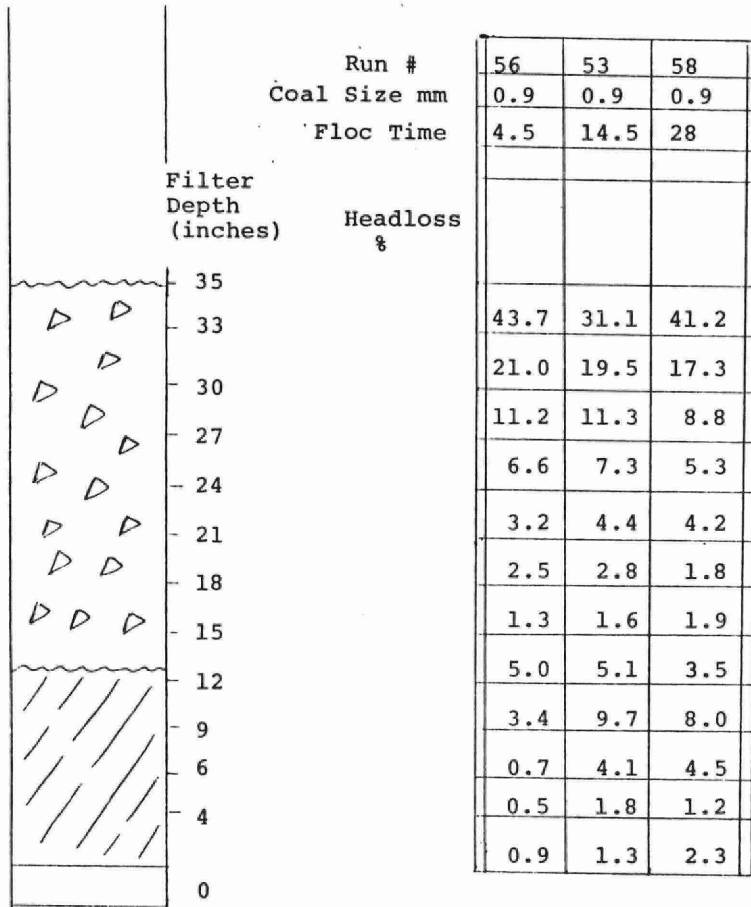
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Appendix 22

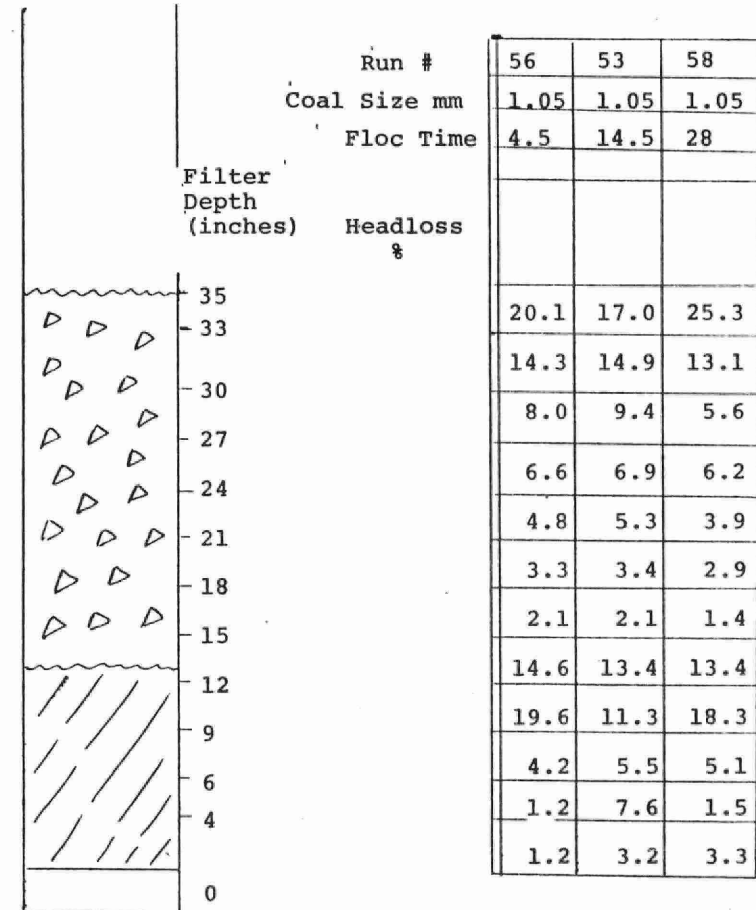
HEADLOSS DISTRIBUTION RESULTS

Flocculation Time

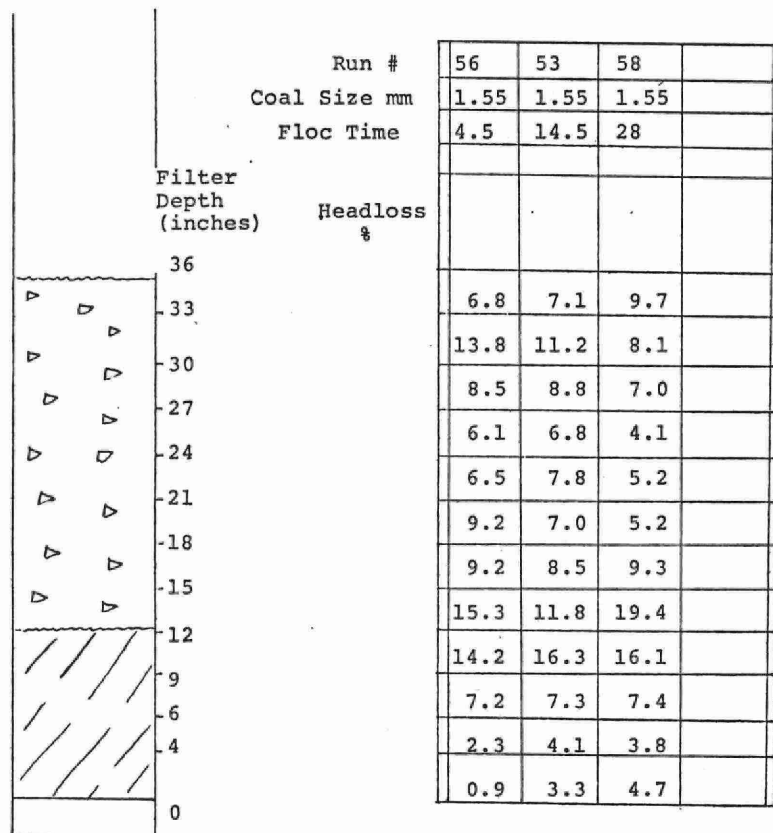


Appendix 22

HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 23

Flocculation Retention Time

Nov. 3, 1973  
Oct. 31, 1973  
Nov. 7, 1973





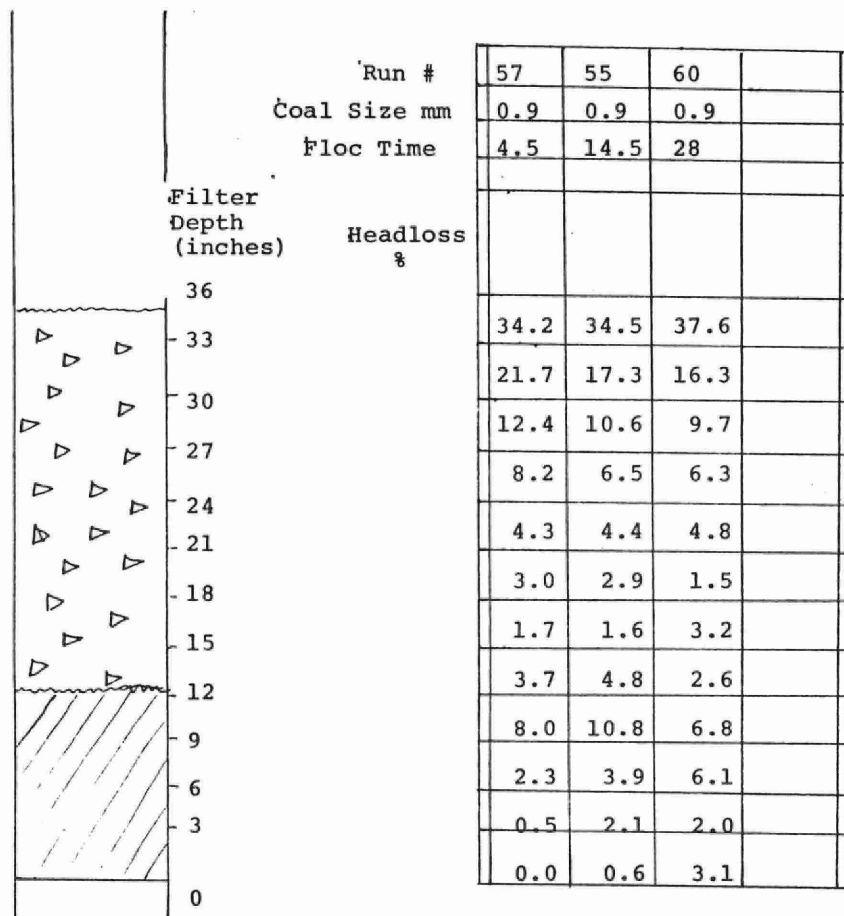
## APPENDIX 23

## DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Nov 3	57	55	13	0.45	22	0.9	4	12	0	14	0.16	300	4.5	8	-	13.0	3100	86	14
			13	0.45	22	1.05	4	12	0	14	0.16	300	4.5	7.5	7.5	17.3	4150	62	38
			13	0.45	22	1.55	4	12	0	14	0.16	300	4.5	7.2	7.2	15.5	3700	37	63
Oct 31	55	55	13	0.45	22	0.9	4	12	0	14	0.14	300	14.5	7.3	7.3	17.0	4080	78	22
			13	0.45	22	1.05	4	12	0	14	0.15	300	14.5	4.5	4.5	13.0	3120	56	44
			13	0.45	22	1.55	4	12	0	14	0.15	300	14.5	4.5	4.5	11.5	2760	34	66
Nov 7	60	50	13	0.45	22	0.9	4	12	0	15	0.14	300	28	6	6	13.0	3100	79	21
			13	0.45	22	1.05	4	12	0	15	0.14	300	28	3.6	3.6	12.0	2900	56	44
			13	0.45	22	1.55	4	12	0	15	0.14	300	28	3.7	3.7	9.5	2300	29	71

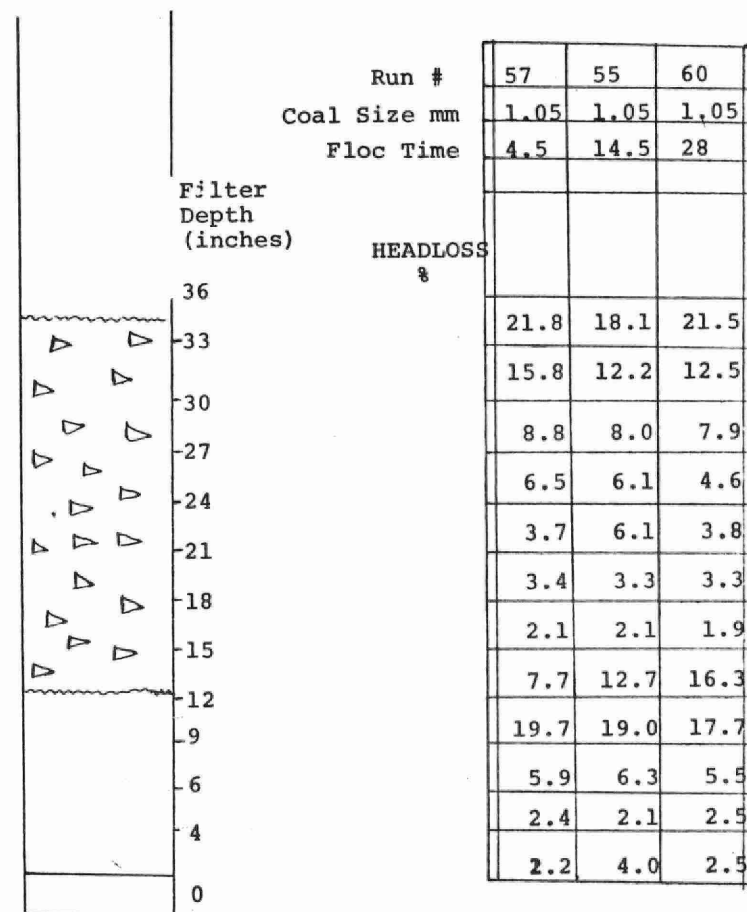
Appendix 23

HEADLOSS DISTRIBUTION RESULTS



APPENDIX 23

HEADLOSS DISTRIBUTION RESULTS



## APPENDIX 23

## HEADLOSS DISTRIBUTION RESULTS

Filter Depth (inches)	Run #		
	Coal Size mm		
Floc Time	Headloss %		
36	57	55	60
33	1.55	1.55	1.55
30	4.5	14.5	28
27			
24			
21			
18			
15			
12			
9			
6			
4			
0			

APPENDIX 24

Flocculation Retention Time

Jan. 31, 1974  
Jan. 28, 1974  
Jan. 30, 1974  
Feb. 4, 1974  
Feb. 5, 1974



## APPENDIX 24

## DIRECT FILTRATION

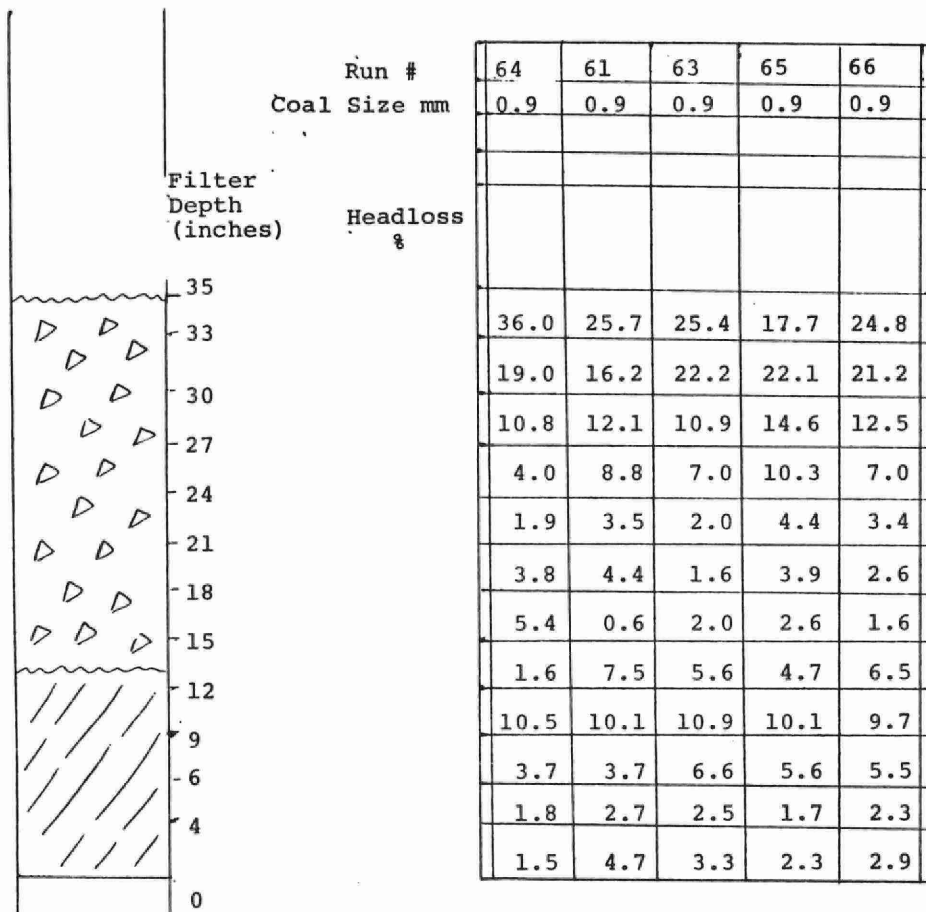
Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution			
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %		
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU										
Jan 31	64	33	13	0.45	22	0.9	4	12	0	11	0.20	20	4.5	8	-	18	4300	76	24		
			13	0.45	22	1.05	4	12	0	11	0.20	20	4.5	6.2	6.2	17.3	4150	59	41		
			13	0.45	22	1.55	4	12	0	11	0.20	20	4.5	6.3	6.3	15.3	3650	36	64		
Jan 28	61	33	13	0.45	22	0.9	4	12	0	14	0.23	20	14.5	5.8	5.8	15.0	3600	71	29		
			13	0.45	22	1.05	4	12	0	14	0.20	20	14.5	4.3	4.3	13.5	3250	57	43		
			13	0.45	22	1.55	4	12	0	14	0.23	20	14.5	4.3	4.3	11.8	2850	37	63		
Jan 30	63	33	13	0.45	22	0.9	4	12	0	13	0.20	20	28	4.2	4.2	10.5	2500	69	31		
			13	0.45	22	1.05	4	12	0	13	0.20	20	28	2.8	2.8	9.5	2300	56	44		
			13	0.45	22	1.55	4	12	0	13	0.20	20	28	3.0	3.0	8.0	1900	35	65		
Feb 4	65	33	13	0.45	22	0.9	4	12	0	14	0.20	20	4.5	7.4	7.4	17.7	4250	73	27		
			13	0.45	22	1.05	4	12	0	14	0.20	20	4.5	5.5	5.5	15.0	3600	57	43		
			13	0.45	22	1.55	4	12	0	14	0.20	20	4.5	5.4	5.4	13.3	3200	32	68		
Feb 5	66	33	13	0.45	22	0.9	4	12	0	14	0.18	20	28	4.0	4.0	11.0	2650	72	28		
			13	0.45	22	1.05	4	12	0	14	0.20	20	28	3.1	3.1	9.5	2300	49	51		
			13	0.45	22	1.55	4	12	0	14	0.20	20	28	3.1	3.1	7.8	1900	31	69		
										* turbidity added to raw											

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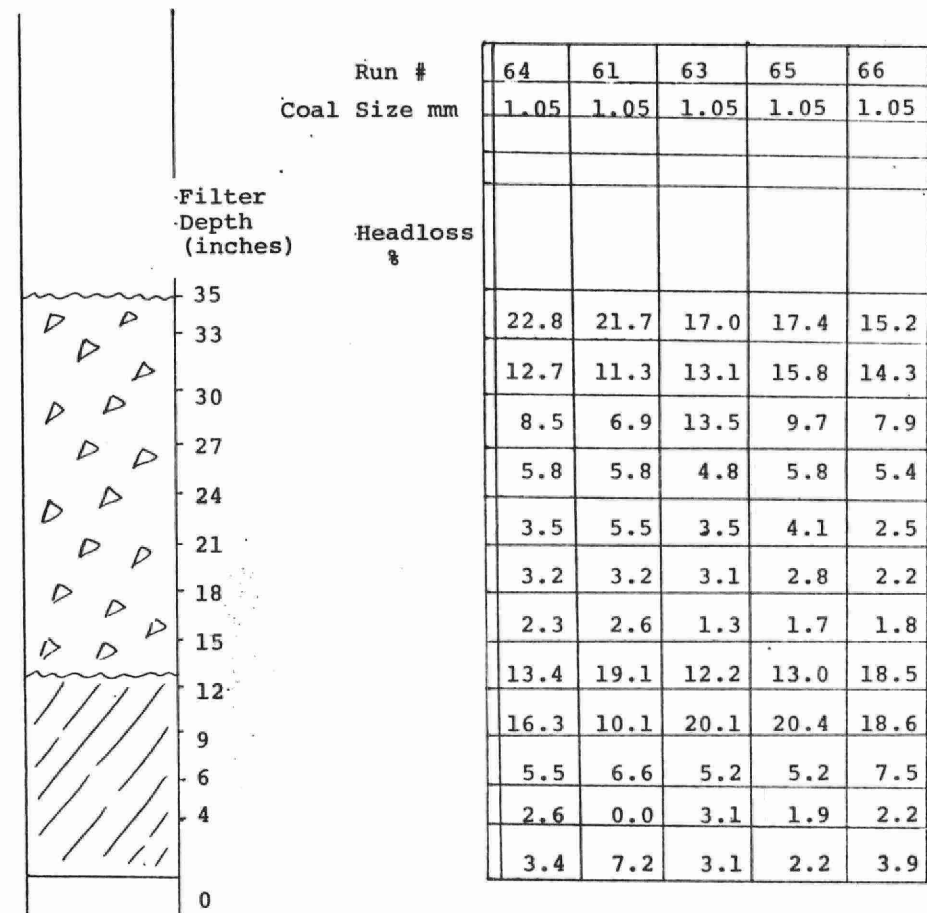
APPENDIX 24

HEADLOSS DISTRIBUTION RESULTS

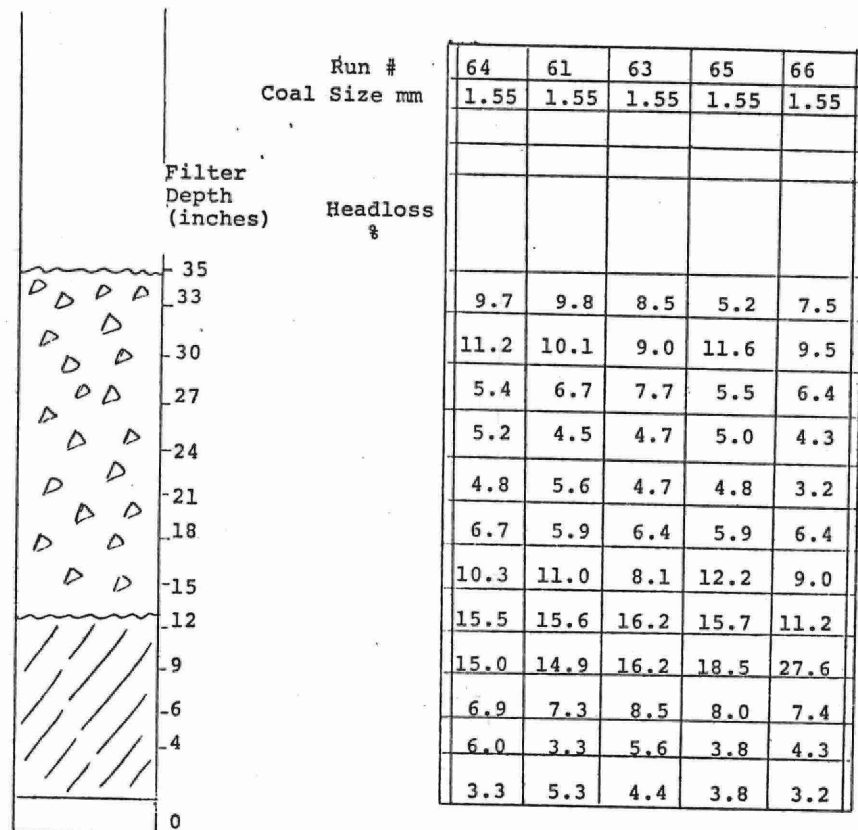


APPENDIX 24

HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 25 & 26

Low Temperature Filtration 1972

Feb. 15, 1972  
Feb. 17, 1972  
Feb. 22, 1972  
Feb. 29, 1972  
Mar. 1, 1972  
Mar. 28, 1972  
Apr. 3, 1972  
Apr. 24, 1972





APPENDIX 25

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Feb 15	T-1	37	11	0.45	16	1.0	4	10	0.12	10	0.35	20	18	8	-	28.5	6850	58	42
			12	0.45	16	1.2	4	10	0.12	10	0.35	20	18	8	-	25.5	6100	52	48
			12	0.45	16	1.4	4	10	0.12	10	0.4	20	18	8	-	31	7450	50	50
			16	0.45	20	1.7	4	10	0.12	10	0.35	20	18	8	-	26	6250	22	78
Feb 17	T-2	36.5	11	0.45	16	1.0	4	25	0.12	10	0.05	20	18	6	6	10.5	2500	64	36
			12	0.45	16	1.2	4	25	0.12	10	0.05	20	18	6	6	10	2400	54	46
			12	0.45	16	1.4	4	25	0.12	10	0.05	20	18	5.0	5.0	11	2650	60	40
			16	0.45	20	1.7	4	25	0.12	10	0.05	20	18	5.5	5.5	11	2650	39	61
Feb 22	T-3	35.5	11	0.45	16	1.0	4	10	0.12	25	0.4	20	18	8	-	21	5050	59	41
			12	0.45	16	1.2	4	10	0.12	25	0.4	20	18	8	-	22	5300	58	42
			12	0.45	16	1.4	4	10	0.12	25	0.45	20	18	8	-	26	6250	55	45
			16	0.45	20	1.7	4	10	0.12	25	0.4	20	18	8	-	26	6250	28	72
Feb 29	T-4	38	11	0.45	16	1.0	4	10	0	25	0.40	20	18	4.5	4.5	14	3350	57	43
			12	0.45	16	1.2	4	10	0	25	0.35	20	18	4.5	4.5	16	3850	38	62
			12	0.45	16	1.4	4	10	0	25	0.45	20	18	4.0	4.0	12.5	3000	53	47
			16	0.45	20	1.7	4	10	0.110	25	0.35	20	18	8	-	20	4800	38	62
* turbidity added to raw																			

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\* turbidity added to raw



APPENDIX 26

DIRECT FILTRATION

APPENDIX 20

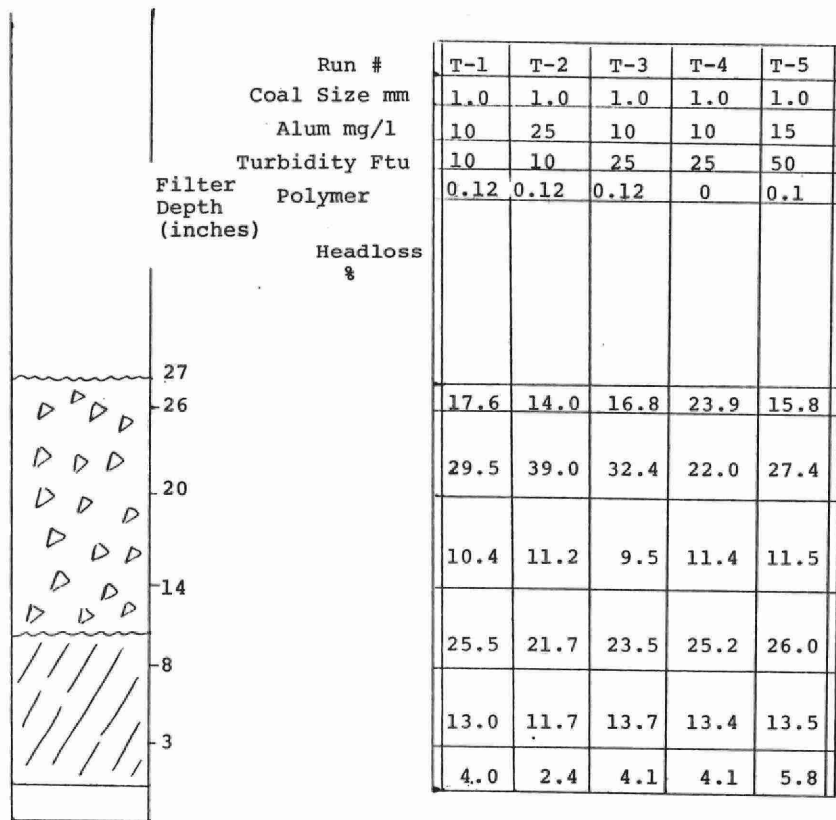
DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm **	FTU *	FTU								
Mar 2	T-5	37.5	11	0.45	16	1.0	4	15	0.1	50	0.5	20	18	5	5	14	3350	55	45
			12	0.45	16	1.2	4	15	0.1	50	0.4	20	18	5	5	12	2900	37	63
			12	0.45	16	1.4	4	15	0.1	50	0.5	20	18	3.8	3.8	13	3100	47	53
			16	0.45	20	1.7	4	15	0.1	50	0.5	20	18	6	6	16	3850	29	71
Mar 28	T-6	37	12	0.45	16	1.0	2	10	0	10	0.3	20	42	4.5	4.5	50	6000	61	39
			12	0.45	16	1.2	2	10	0	10	0.3	20	42	4.5	4.5	56	6700	55	45
			12	0.45	16	1.4	2	10	0	10	0.3	20	42	4.2	4.2	58	6950	57	43
			12	0.45	18	1.55	2	10	0	10	0.3	20	42	5.5	5.5	60	7200	42	58
Apr 3	T-7	37	12	0.45	16	1.0	2	13	0.11	10	0.25	20	42	8	-	56	6700	82	18
			12	0.45	16	1.2	2	13	0.11	10	0.25	20	42	8	-	62	7450	70	30
			12	0.45	16	1.4	2	13	0.11	10	0.25	20	42	8	-	78	9350	70	30
			12	0.45	18	1.55	2	13	0.11	10	0.25	20	42	8	-	68	8150	67	33
Apr 4	T-8	37	12	0.45	16	1.0	6	10	0.10	4	0.3	20	18	8	-	12.5	4500	64	36
			12	0.45	16	1.2	6	10	0.10	4	0.3	20	18	8	-	13.1	4700	52	48
			12	0.45	18	1.55	8	10	0.10	4	0.3	20	18	8	-	11.2	5350	40	60

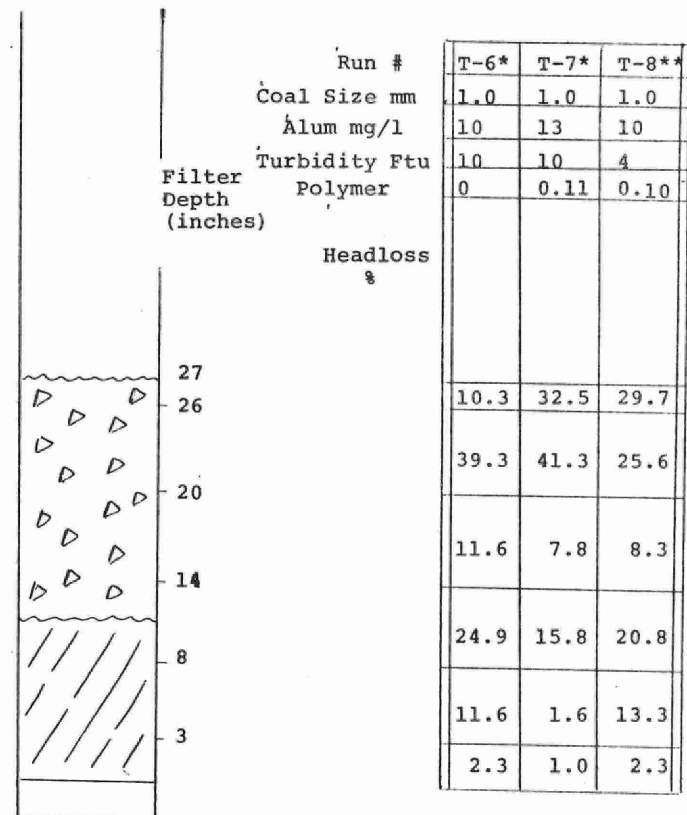
\* Turbidity added to raw

\*\* Separan NP10

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS

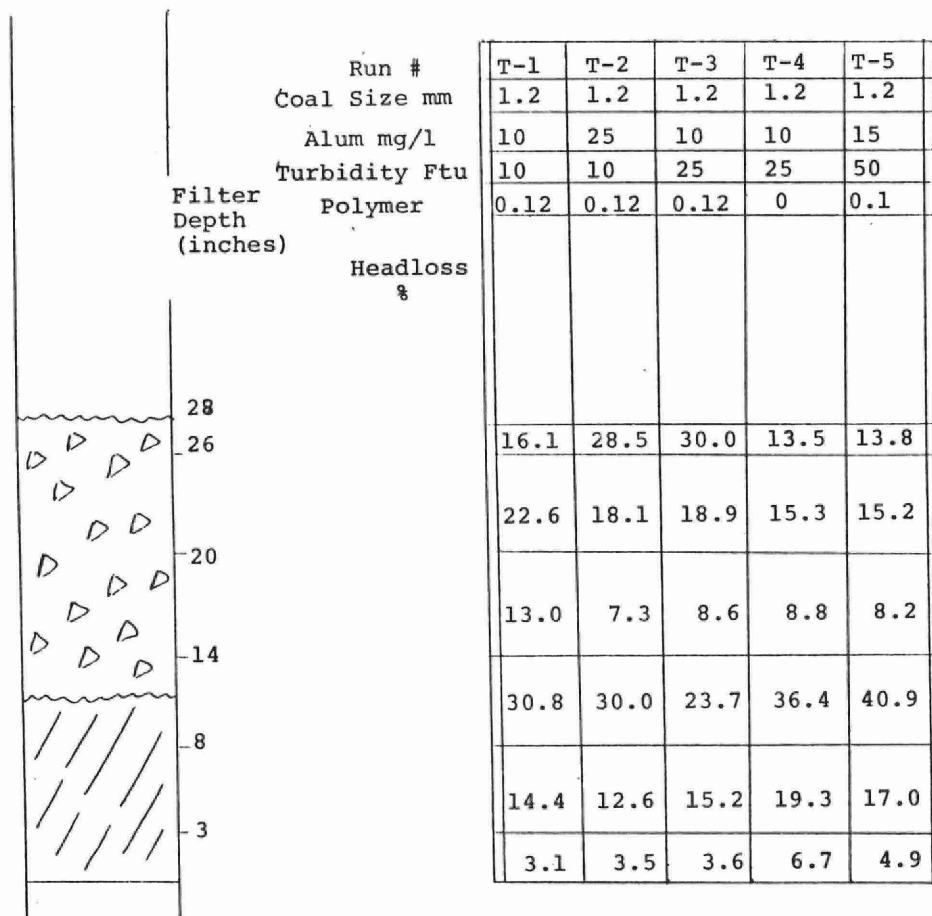


\* Filtration Rate: 2 Igpm/sq ft

\*\* Filtration Rate 6 Igpm/sq ft

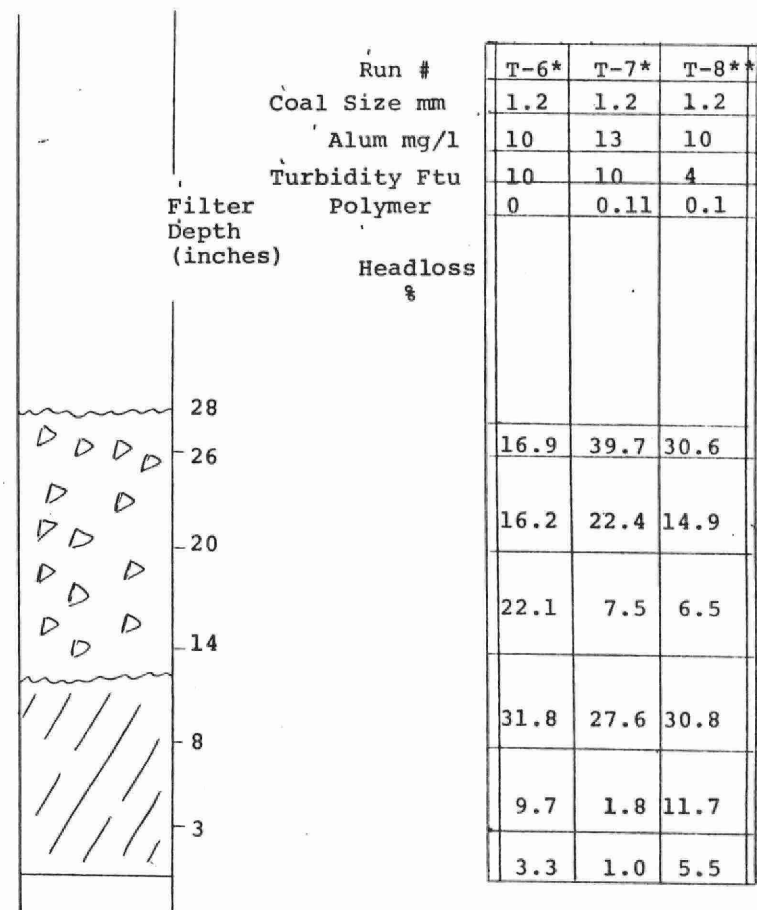
## APPENDIX 25-26

## HEADLOSS DISTRIBUTION RESULTS



## APPENDIX 26

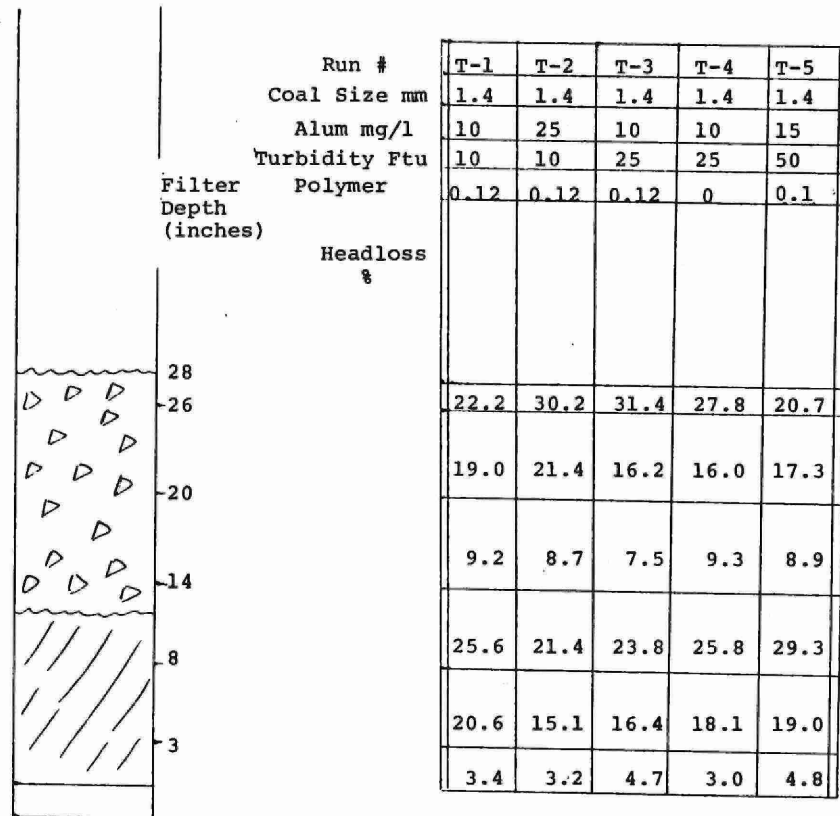
## HEADLOSS DISTRIBUTION RESULTS



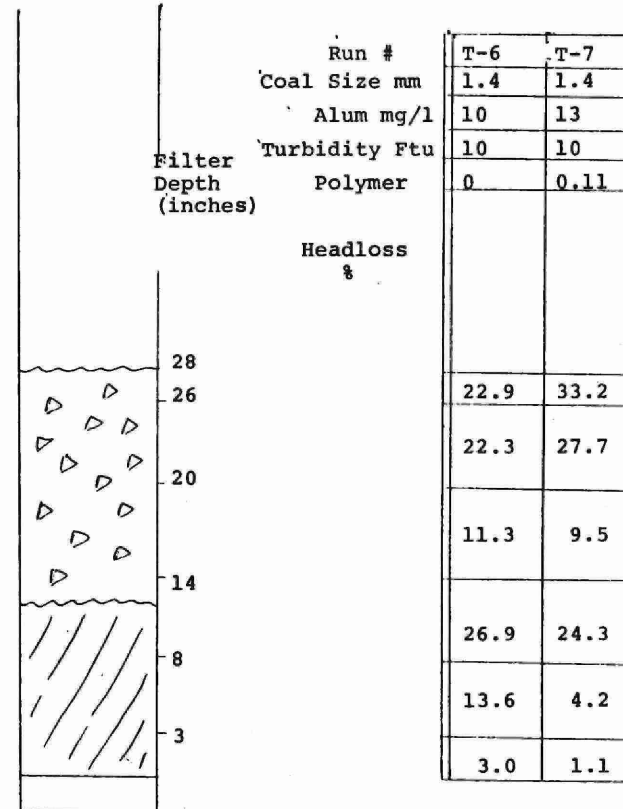
\* Filtration Rate 2 Igpm/sq ft

\*\* Filtration Rate 6 Igpm/sq ft

## HEADLOSS DISTRIBUTION RESULTS

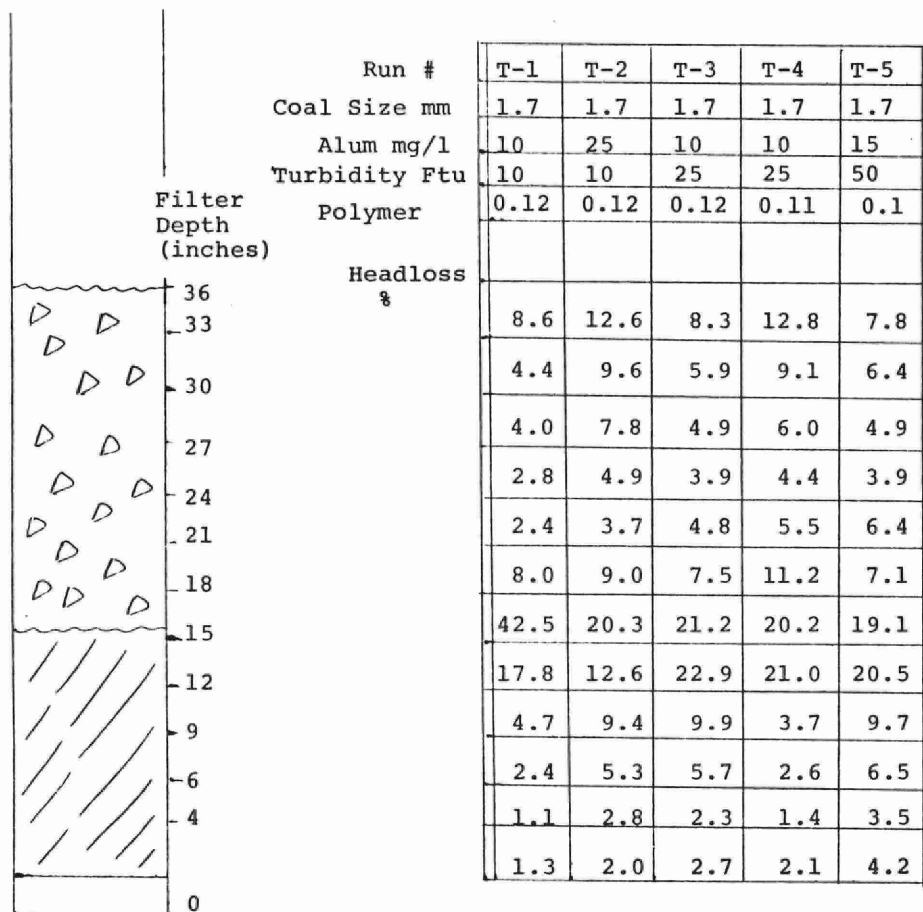


## HEADLOSS DISTRIBUTION RESULTS



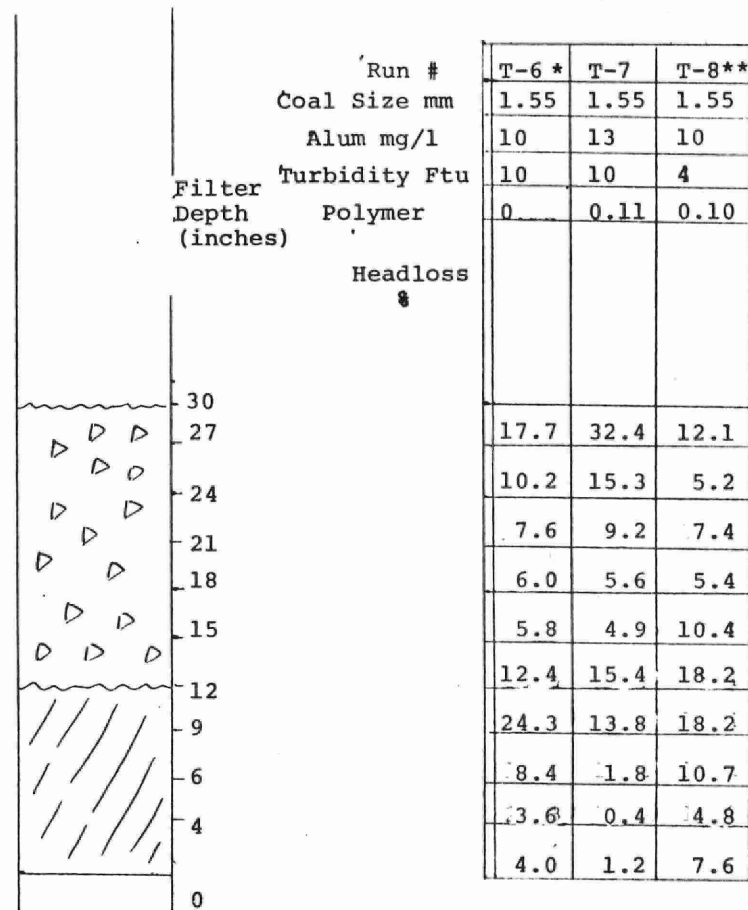
## APPENDIX 25-26

## HEADLOSS DISTRIBUTION RESULTS



## APPENDIX 26

## HEADLOSS DISTRIBUTION RESULTS



\* Filtration Rate 2 Igpm/sq ft

\*\* Filtration Rate 8 Igpm/sq ft

APPENDIX 27

Low Temperature Filtration 1974

Feb. 4, 1974  
Feb. 5, 1974  
Feb. 6, 1974  
Feb. 7, 1974  
Feb. 8, 1974

APPENDIX 27

DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU +	FTU								
Feb 4	65	33	13	0.45	22	0.9	4	12	0	14	0.20	20	4.5	7.4	7.4	17.7	4250	76	24
			13	0.45	22	1.05	4	12	0	14	0.20	20	4.5	5.5	5.5	15.0	3600	57	43
			13	0.45	22	1.55	4	12	0	14	0.20	20	4.5	5.4	5.4	13.3	3200	32	68
Feb 5	66	33	13	0.45	22	0.9	4	12	0	14	0.18	20	28	4	4	11.0	2650	73	27
			13	0.45	22	1.05	4	12	0	14	0.20	20	28	3.1	3.1	9.5	2300	49	51
			13	0.45	22	1.55	4	12	0	14	0.20	20	28	3.1	3.1	7.8	1900	31	69
Feb 6	67	33	13	0.45	22	0.9	4	19	0.105*	32	0.23	20	28	7.0	7.0	9.3	2250	76	24
			13	0.45	22	1.05	4	19	0.110*	32	0.23	20	28	5.5	5.5	8.8	2100	55	45
			13	0.45	22	1.55	4	19	0.110*	32	0.23	20	28	5.4	5.4	7.5	1800	32	68
Feb 7	68	33	13	0.45	22	0.9	4	18	0.105**	30	0.19	20	28	8	-	3.0	700	96	4
			13	0.45	22	1.05	4	10	0.105**	31	0.21	20	28	8	-	4.4	1050	94	6
			13	0.45	22	1.55	4	18	0.105**	31	0.19	20	28	8	-	5.7	1350	94	6
Feb 8	69	33	13	0.45	22	0.9	4	18	0.100**	31	0.16	20	28	8+	-	10.2	2450	68	32
			13	0.45	22	1.05	4	18	0.100**	31	0.18	20	28	5.6	5.6	10.0	2400	53	47
			13	0.45	22	1.55	4	18	0.100**	31	0.16	20	28	6.1	6.1	10.0	2400	43	57
								*Separan NP10		** Purifloc N20		***Naicolylte 8171 + Turbidity added to raw							

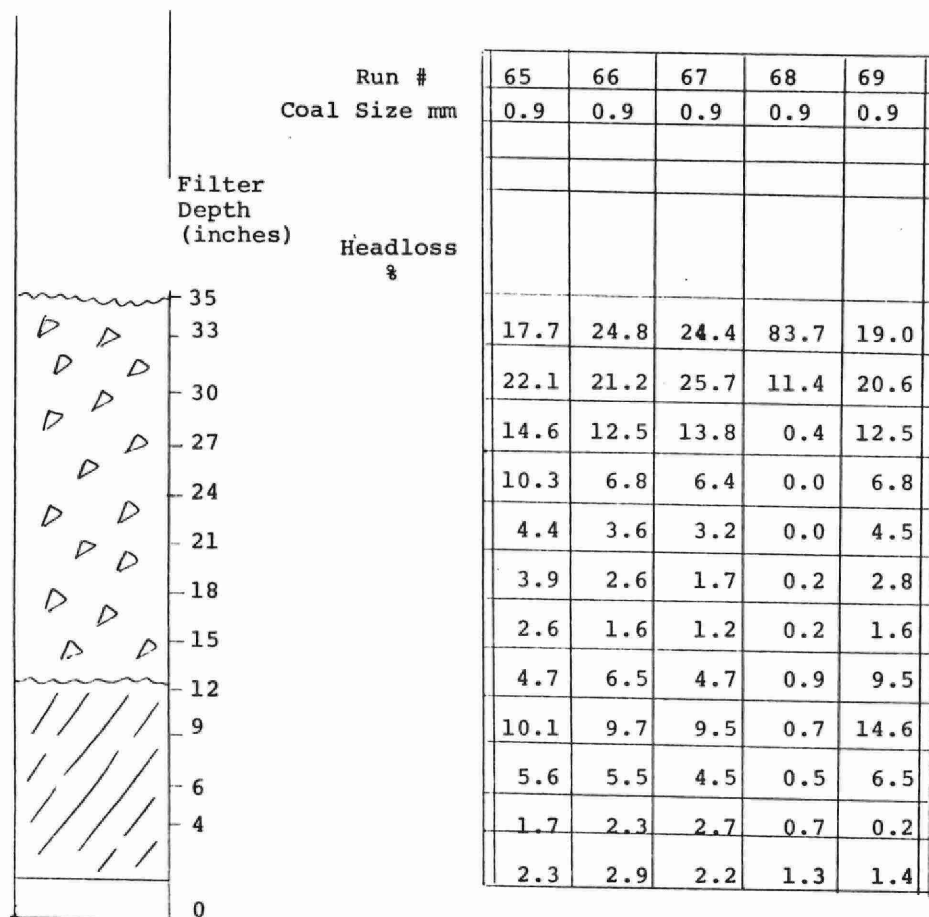
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-105-



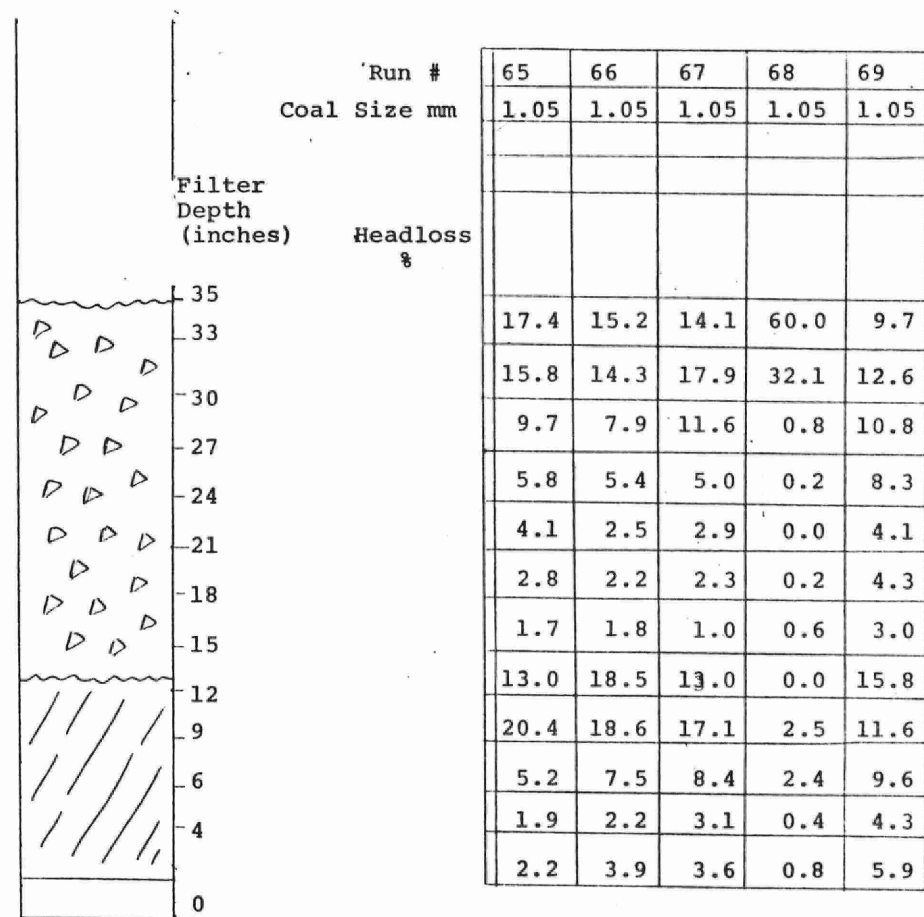
## APPENDIX 27

## HEADLOSS DISTRIBUTION RESULTS

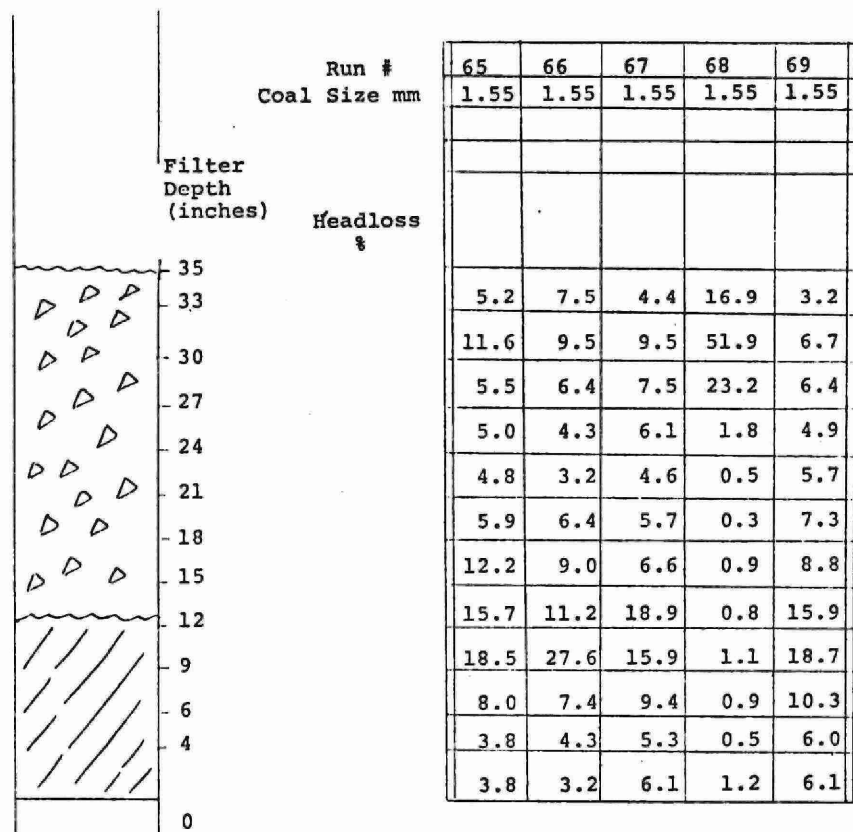


## APPENDIX 27

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 28

Low Temperature Filtration 1974

Jan. 28, 1974  
Jan. 29, 1974  
Jan. 30, 1974  
Jan. 31, 1974



APPENDIX 26

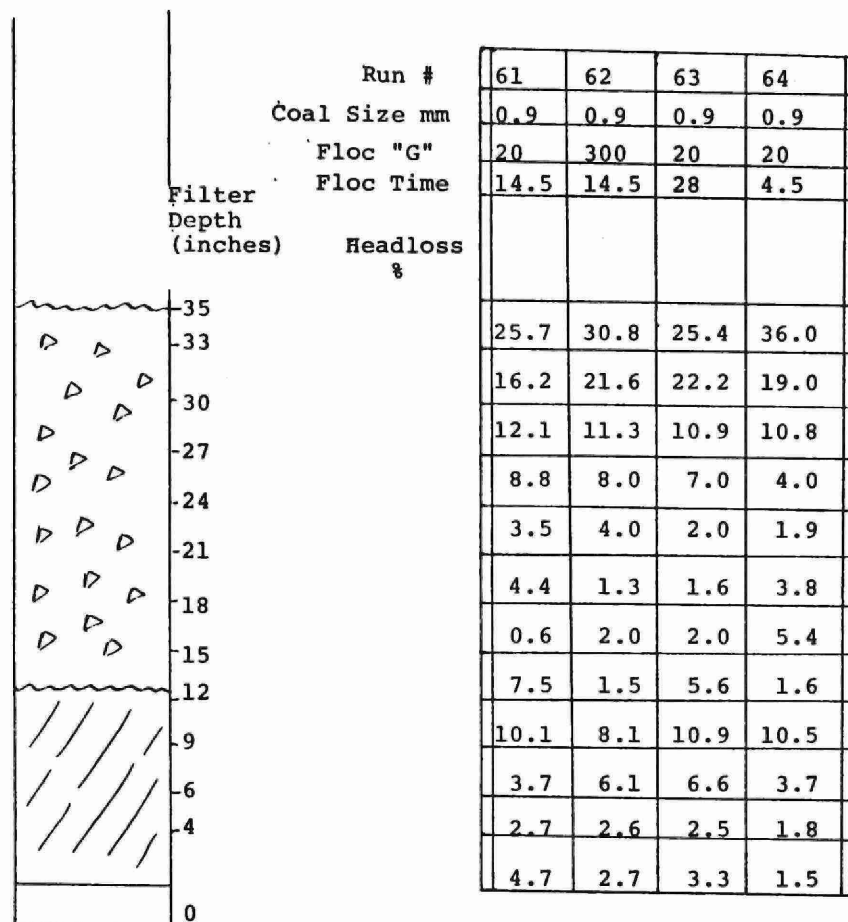
DIRECT FILTRATION

Date	Run #	Temp °F	Filter Media				Filtration Rate IGPM/ft <sup>2</sup>	Chemicals		Turbidity		Flocculation		Head Loss Ft.		Run Length Hours	Total Filtered Imp. Gal/ft <sup>2</sup>	Head Loss Distribution	
			Sand		Coal			Alum	Poly	Raw	Eff.	G Sec <sup>-1</sup>	Time min.	Final	Break Through			Coal %	Sand %
			Depth in.	Eff. mm	Depth in.	Eff. mm		ppm	ppm	FTU *	FTU								
Jan 28	61	33	13	0.45	22	0.9	4	12	0	14	0.23	20	14.5	5.8	5.8	15.0	3600	71	29
			13	0.45	22	1.05	4	12	0	14	0.20	20	14.5	4.3	4.3	13.5	3250	57	43
			13	0.45	22	1.55	4	12	0	14	0.23	20	14.5	4.3	4.3	11.8	2850	37	63
Jan 29	62	33	13	0.45	22	0.9	4	12	0	14	0.22	300	14.5	6.0	6.0	10.8	2600	77	23
			13	0.45	22	1.05	4	12	0	14	0.22	300	14.5	4.3	4.3	9	2150	54	46
			13	0.45	22	1.55	4	12	0	14	0.23	300	14.5	4.3	4.3	7.5	1800	38	62
Jan 30	63	33	13	0.45	22	0.9	4	12	0	13	0.20	20	28	4.2	4.2	10.5	2500	69	31
			13	0.45	22	1.05	4	12	0	13	0.20	20	28	2.8	2.8	9.5	2300	56	44
			13	0.45	22	1.55	4	12	0	13	0.20	20	28	3	3	8.0	1900	35	65
Jan 31	64	33	13	0.45	22	0.9	4	12	0	11	0.20	20	4.5	8+	-	18	4300	76	24
			13	0.45	22	1.05	4	12	0	11	0.20	20	28	6.2	6.2	17.3	4150	59	41
			13	0.45	22	1.55	4	12	0	11	0.20	20	4.5	6.3	6.3	15.3	3650	36	64

\* turbidity added to raw

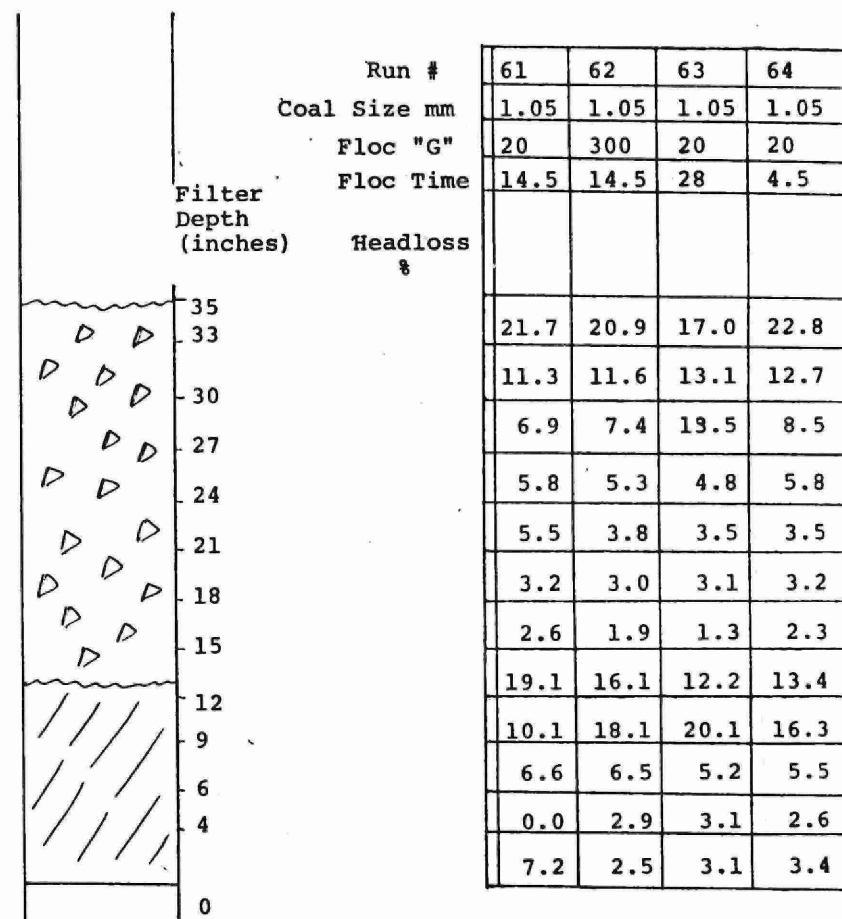
## APPENDIX 28

## HEADLOSS DISTRIBUTION RESULTS

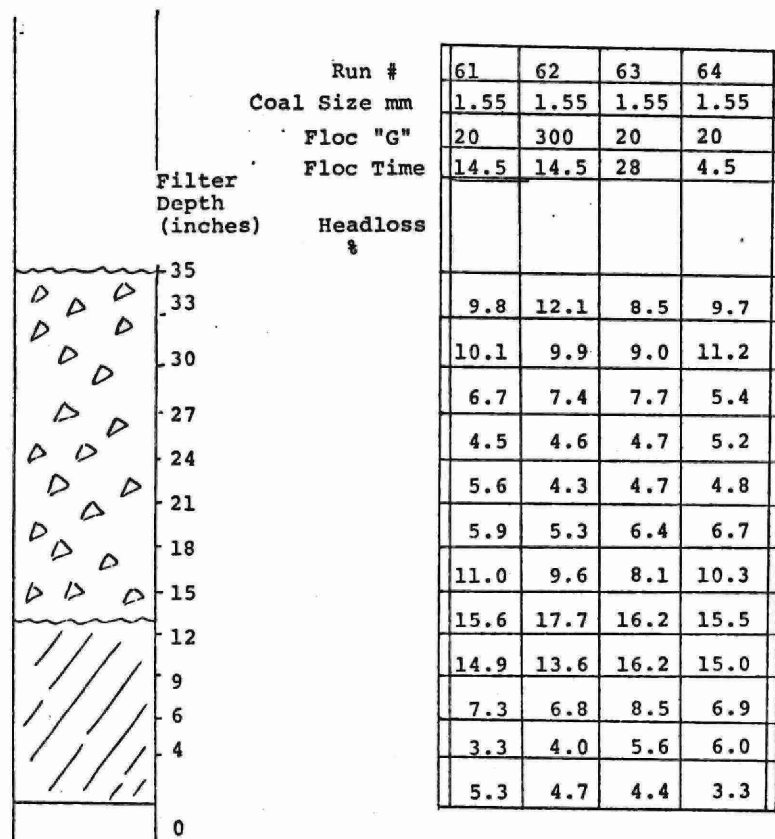


## APPENDIX 28

## HEADLOSS DISTRIBUTION RESULTS



## HEADLOSS DISTRIBUTION RESULTS



APPENDIX 29

Declining Rate Filtration

Nov. 9-11, 1972	Harrow
July 14, 1972	Sarnia
July 17, 1972	Sarnia
Aug. 2, 1972	Sarnia



## APPENDIX 29

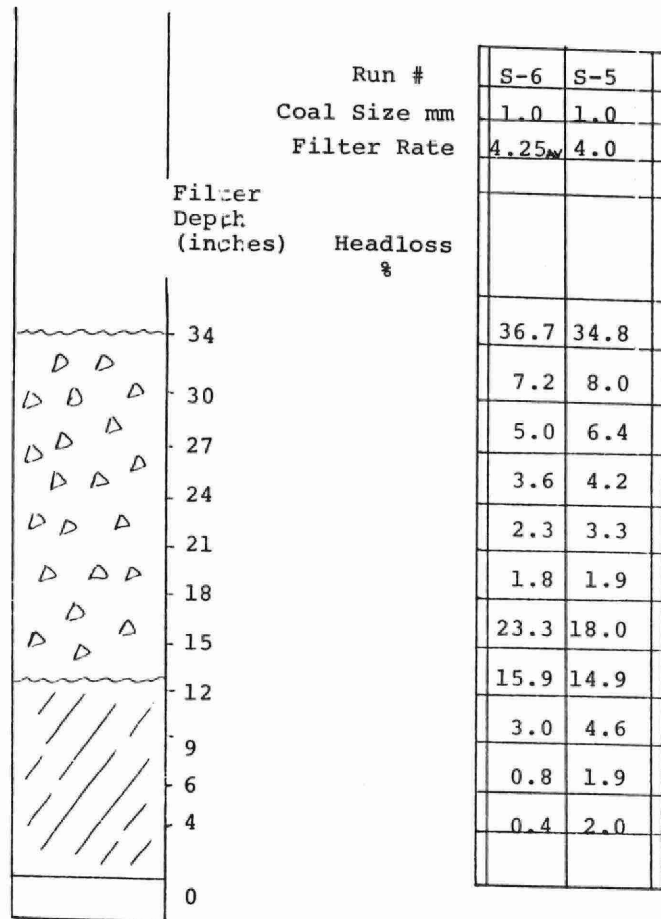
## DIRECT FILTRATION

[illegible]



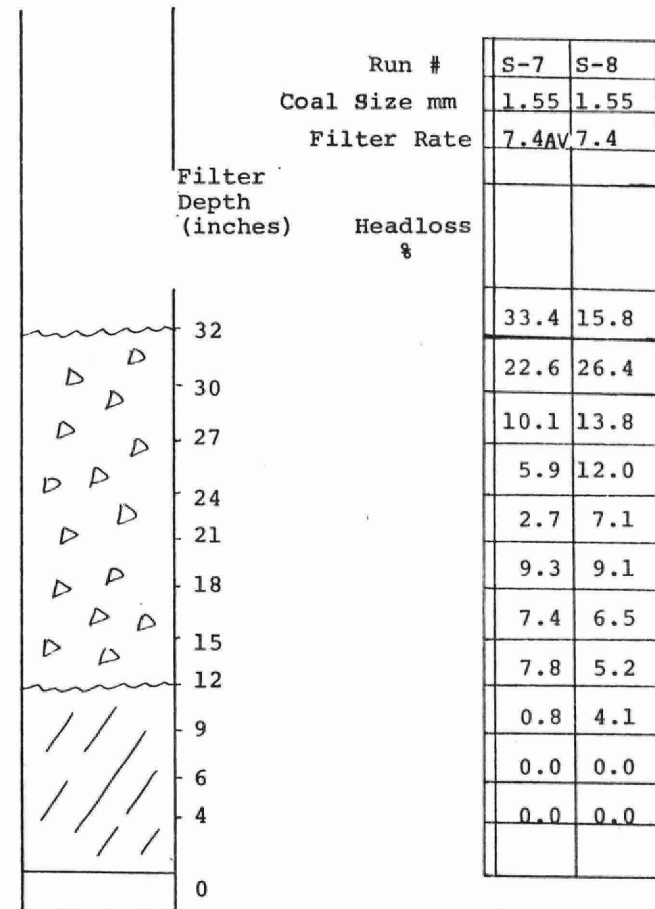
# APPENDIX 29

## HEADLOSS DISTRIBUTION RESULTS



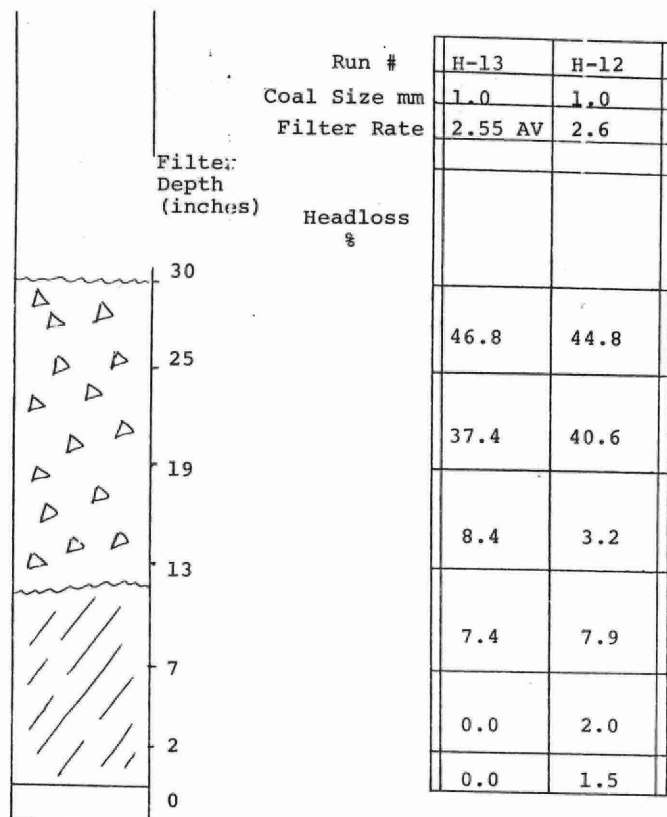
# Appendix 29

## Headloss Distribution Results



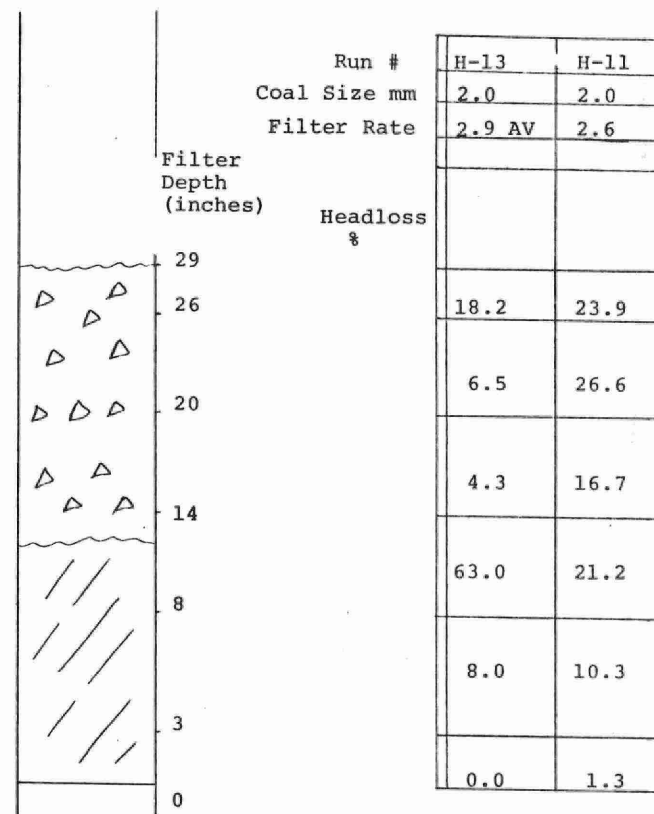
## APPENDIX 29

## HEADLOSS DISTRIBUTION RESULTS



## APPENDIX 29

## HEADLOSS DISTRIBUTION RESULTS





\*96936000009321\*